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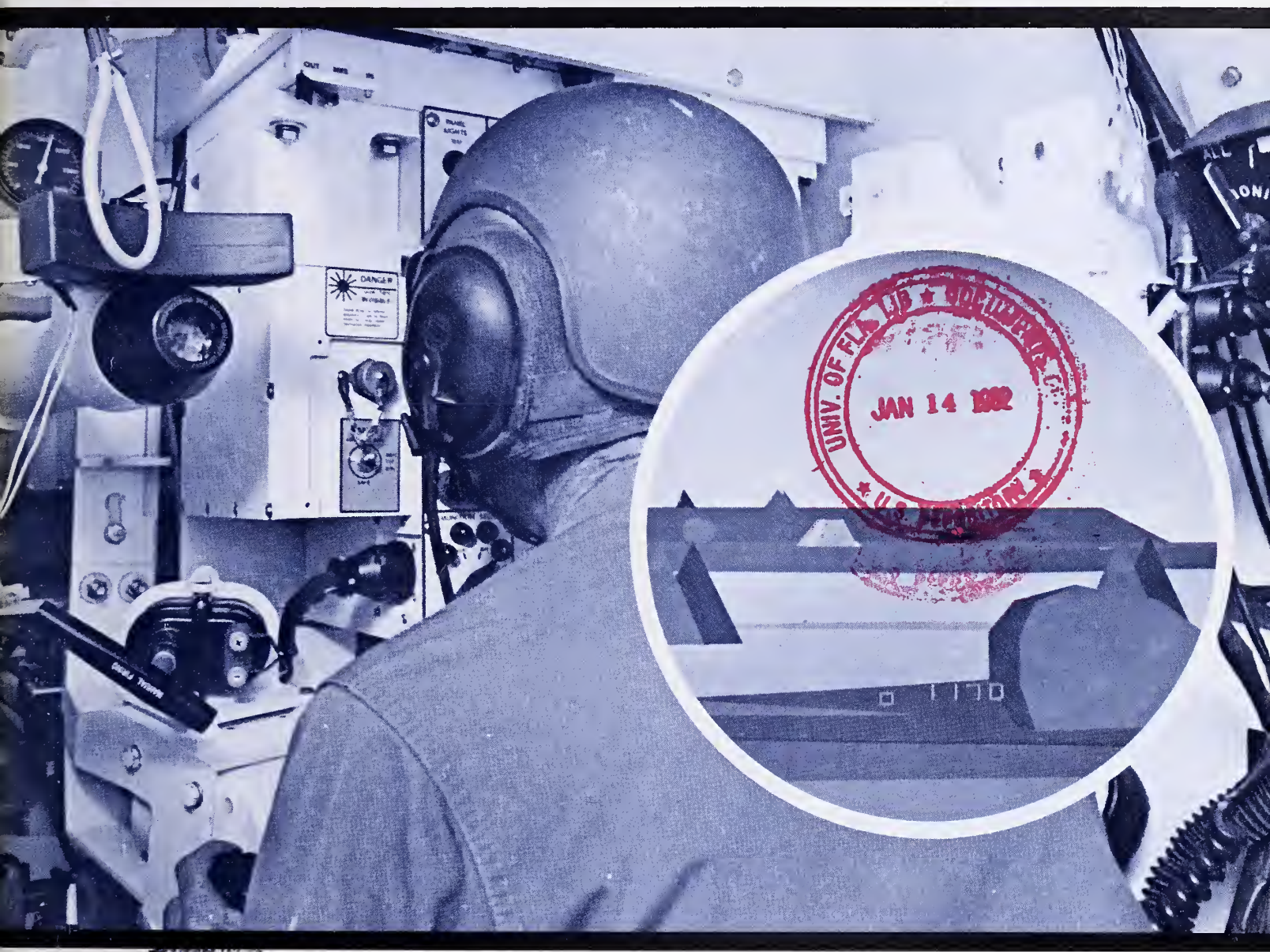

COFT...

A NEW DIMENSION IN TRAINING

ARMY R,D&A

Vol. 22 No. 6 **November-December 1981**

OFFICIAL MAGAZINE OF THE RDA COMMUNITY, established 1959

ABOUT THE COVER:

COFT (Conduct of Fire Trainer), developed for the M1 Abrams and M60-series tanks, gives the student realistic training through simulation, without associated tank operational costs. On the back cover is a view of the COFT crew station, a near-replica of the inside of a tank.

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FEATURES

DEPARTMENTS

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Purpose: To improve informal communication among all segments of the Army scientific community and other government R,D&A agencies; to further understanding of Army R,D&A progress, problem areas and program planning, to stimulate more closely integrated and coordinated effort among Army R,D&A activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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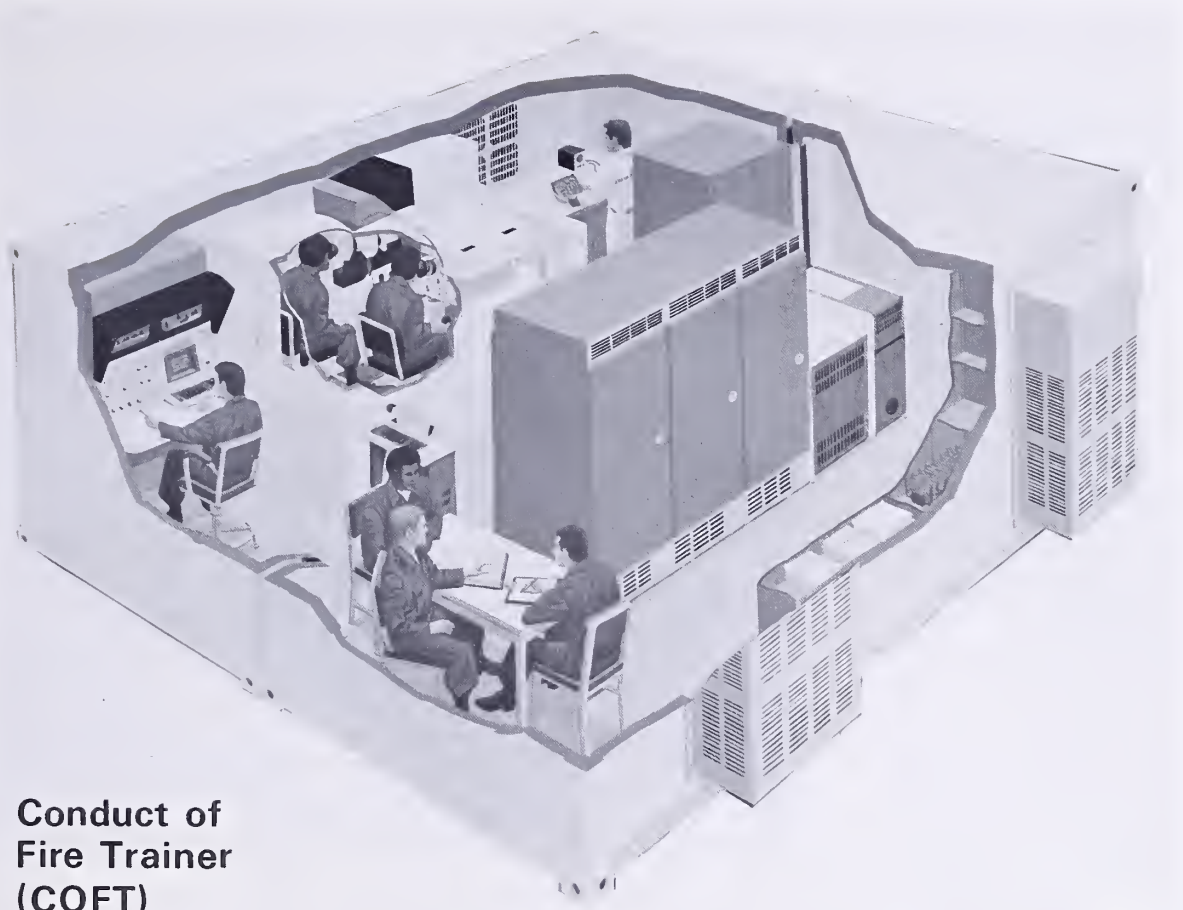


Conduct of Fire Trainer (COFT)

Fig. 1.

A New Era for Gunnery Training

By MAJ Francis C. Lawler

Both military and commercial users of aircraft have long known of the advantages of using simulators for training pilots and crew members. As the cost of fuel, ammunition and maintenance continues to rise, the U.S. Army has responded to the need to reduce the use of these critical assets by development of a Conduct of Fire Trainer (COFT) for precision gunnery training of combat vehicle crews.

The U.S. Army's Project Manager for Training Devices (PM TRADE), located in Orlando, FL, is chartered to act as the U.S. Army Materiel Development and Readiness Command's agent for training device development and acquisition. Acting in this role, PM TRADE is directing the development, evaluation and acquisition of this training device.

Late in 1979, contracts for competitive development of the Conduct of Fire Trainer for the M1 Abrams and M60-series tanks were awarded to Chrysler Defense, Inc., and General Electric's Simulation and Control Systems Department. Subsequently, June 1980, these contracts were modified to include development of a COFT for the Fighting Vehicles, M2 and M3. The trainers were to have stations for the vehicle commander and gunner, plus an instructor console to control the training exercise and evaluate the student's performance.

Prototype trainers for the M1 Abrams tank were delivered by both contractors to Fort Hood in May 1981, and after technical acceptance and performance evaluations, the General Electric candidate device was selected to undergo operational evaluation. Operational testing of the M1 Abrams COFT prototype was conducted from July through September 1981, and testing of the M2/3 Fighting Vehicle version began in September 1981. Total cost of the development program is approximately $33 million.

The General Electric Conduct of Fire Trainer is a transportable, shelterized gunnery simulator which uses computer-based visual simulation technology to create an environment that is ideal for learning. The trainer produces full-color computer-generated action scenes in which vehicle crew members can see and interact with multiple threat target situations; yet, there is no danger to the crew, no

fuel is consumed, and no ammunition is expended. In addition to saving fuel and ammunition costs, the training device has other advantages:

• Training can be conducted at any time - day, night, weekends; visibility variations can be scheduled in the simulator; similated engagements can be reenacted; and degraded modes of gunnery operations can be practiced.

• The shelterized trainer, as shown in Figure 1, has training stations for the vehicle commander and the gunner. Like the M1 tank, the training unit's computer-stabilized fire control system supports accurate firing while the simulated vehicle is on the move. To enhance the realism of the training exercise, the crew station faithfully reproduces the appearance and functions of the vehicle's operating controls, indicators, and weapon sights.

• Characteristics such as appropriate diopter adjustment, exit pupil, optical transmission properties, field of view, magnification selection, sight reticles, and filter/shutter appearance are all realistically simulated. Even the audible effects of engine and drive train whine, tread clatter, clank of the breech block, as well as gun firing and the sound of spent brass falling on the turret deck are present.

• Computer-generated images are used to represent the scenes viewed by crew members training in the simulator. The special purpose computer image generator provides full-color, daylight and thermal scenes with various terrain and topographical backgrounds, man-made structures, moving targets, shell trajectories, and special effects that allow vehicle crews to develop gunnery proficiency in a broad range of simulated battle conditions.

• Correct visual perspective is instantaneously computed and maintained for all orientations of the vehicle relative to its targets. The vehicle

Fig. 2. COFT Instructor/Operator Station Showing Video Displays

can move anywhere within the database, allowing full simulation and practice of tactics.

The visual subsystem can present views under normal and degraded visibility conditions and with detail appropriate to the magnification of the sight being used. When simulating the Thermal Imaging System mode, a special infra-red processing algorithm and electronic noise effects are introduced to closely represent actual sight performance. The simulated thermal imagery mode can be used not only for night vision exercises, but also for detecting and attacking daytime targets that are camouflaged by fog, smoke or vegetation.

The Conduct of Fire Trainer generates its views from a digital data base with data retrieved under digital computer control. The retrieved data covers a 70-square kilometer exercise area within the immediate viewing range of the vehicle. Special purpose hardware computes the scenes point-by-point and scanline-by-scanline based upon the geometry of the viewing situation.

The total scene is updated 30 times each second. When the simulated vehicle moves, the magnification changes or the periscope slues, the scene changes just as it would in the real vehicle's viewing system. The 10,000 x 7,000 meter area is an arbitrary area selected for the prototype trainer, and larger data bases can be generated for later versions of the trainer.

Computer-generated weaponry effects highlight the ability of this unique trainer to represent flexible and programmable battle situations in real time. Operators of the simulator can learn to maximize hit probability, especially in situations where the first round may be the only round fired. In fact, first round hits at ranges to several thousand meters can be made consistently in the trainer and

in the M1 when crew men are trained to use the full capabilities of the M1's sophisticated fire control system.

The main gun and machine gun simulation features a realistic portrayal of tracer rounds and projectile impact. Recoil effects are provided by motion imparted to the gun brow pads when the main gun is fired. Accurate ballistic simulation is provided for own-weapon and threat-weapon trajectories, with realistic visual effects for target motion, obscuration, tracer, smoke grenade, hit, kill, and miss conditions.

Weapons simulated by the current trainer configurations include 105mm main gun (M1, M60), 25mm main gun (M2/3), 7.62mm coaxial machine gun, 50 cal machine gun, TOW missile system, and the smoke grenade.

An instructor at the instructor/operator station controls training exercises and evaluates performance (see Figure 2). Full-color video displays are provided at this station so that the instructor can simultaneously view the same scenes presented to the vehicle commander and gunner.

The station incorporates a keyboard terminal and display system to initiate, control, and monitor the activities of the vehicle commander and gunner, and trainee performance. Principally, accuracy and response time are measured and displayed. An intercom system allows the instructor to communicate with the trainees and to simulate radio transmissions. Further, exercises may be selected which simulate system malfunctions in the training situation.

By simulating a wide variety of situations and tactical engagements, the system can provide basic gunnery training and sustain the proficiency of fully qualified crews. A library of preprogrammed exercises is provided which can be loaded and executed from the instructor station, with a training sequence typically progressing from identifying a target, to setting up the weapons system, to aiming the reticle and firing the simulated weapon.

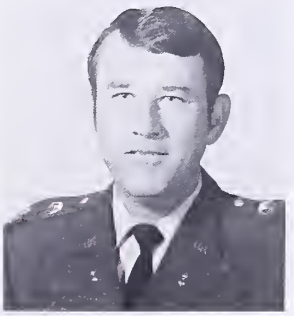
The system has the capability to simulate different times of day or night, including dawn and dusk, and simulated special effects can include rain, smoke, variable fog, and fading to further increase scene realism.

Technical and performance evaluation of the developmental hardware will continue through the remainder of 1981. Early in 1982, a production program will be initiated to build and deploy the trainer worldwide. With minor variations, the basis of issue will be one per battalion equipped with the M1 Abrams or M60 tanks or Fighting Vehicles M2/3, with the Infantry School, Armor School and the 7th Army Training Center also receiving the trainer. The production plan extends through 1988.

The unique training capability offered by the Conduct of Fire Trainer will be complemented by an equally unique support concept, in that it will be supported in the field throughout its life cycle (15 years) by contractor personnel. Unconstrained by traditional support structures and focusing on results and cost effectiveness, the contractor support system will be structured to maintain the trainer at a minimum of 90 percent availability for training in the field.

These new training devices will be a vital supplement to current combat vehicle gunnery training in that the high levels of combat readiness achieved in field training and actual firing can be maintained by using units at their home station unhampered by ammunition, fuel, range availability, weather, time of day and other limits.

Training ammunition assets now required for the more basic gunnery training may be used in more creative, challenging and realistic field training. The training cost avoidance opportunities presented by each Conduct of Fire Trainer are estimated to easily exceed its acquisition cost within three years of fielding.



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Army Science Board Focuses on Critical Issues

Secretary of the Army John O. Marsh Jr., and top Army research, development and acquisition officials reviewed critical issues and presented guidelines to the Army Science Board (ASB), during the Board's Fall General Membership meeting held 14-15 September at Humphreys Hall, Fort Belvoir, VA.

Fifty-five ASB members and about 60 notable Army attendees participated in command briefings/presentations, round-table discussions, and tours provided to present the new administration's guidelines and expectations from the ASB in the near future.

Secretary Marsh thanked the ASB members for their time and talents in advising the Army, then recalled significant developments in American history, beginning with the railroad that gave logistic support to our growing Army.

The Civil War, the first of the "modern wars," utilized the North's industrial strength; the telegraph improved rapid communications; the hot-air balloon provided air observation; the ironclads added a new dimension to armor; and the repeater rifle was the first of our "sophisticated weaponry."

Following the pioneer background of today's complex systems of satellites, computers and smart missiles, the Secretary called on the ASB to provide think-tank assistance to the Army, always keeping in mind simplicity of design, and minimum time and costs involved in transition from development to fielding.

Guidelines were given on multiplicity of systems. More is not better, he said. We need to develop a system of order and selectivity for our future systems . . . and in developing our systems, we must have the capability to nullify potential enemy systems, or, in turn, to effect countermeasures through electronics-countermeasures.

On technical breakthroughs, Secretary Marsh said that we need to keep a tighter rein on security and prevent adversaries from being privileged to the same information.

"The best answer to strength and

ASB Summer Study Cites Need for Greater Technological Advancements

Some of the most brilliant minds in America spent an intensive period of study during 1981, to advise Secretary of the Army John O. Marsh, Jr., what courses of action the Army might take in the science and engineering fields that could have a major impact on how the Army of the 1990-2000 era could be equipped to provide the greatest potential combat capability.

The 1981 Army Science Board Summer Study, "Equipping the Army: 1990-2000," was headed by Dr. Russell D. O'Neal, former ASA (R & D) and currently a member of the Army Science Board. Participants included 14 other members of the Army Science Board and about 40 Army employees, military and civilian. The Army Science Board is composed of industrial, academic, and private consultants - persons eminently successful and respected in their individual fields.

The overall study is classified SECRET but some aspects have been released. It was reported that there was a need for the Army to orient its thinking toward a global strategy so that its forces will be responsive to the entire spectrum of conflict possibilities. The task of overcoming the momentum built up by the Soviets during the past 10-15 years was noted as great. However, the group concluded that major factors in making the Army of the 1990-2000 a truly potent force lay in taking full advantage of technology and utilizing the national economy more efficiently.

The U.S. GNP, the study noted, is three times that of the USSR. When the GNP of the NATO allies is added to that of the U.S., the advantage increases greatly. U.S. industry and defense excel in such fields as aviation, missiles, and space. Further, the U.S. excels overall in electronics, with young Americans growing up in a highly technical society in which they become as adept in this field as their grandfathers were with repairing Model A Fords. These are assets that should be exploited.

The group further noted its belief that in addition to these inherent advantages, the U.S. Army can do a better job at training its people than the Red Army can, utilizing a bank account of combat experienced NCOs and officers, plus modern equipment, and extensive use of modern training facilities such as the new National Training Center.

The Soviet lead can be overcome, the study members agreed, but not through a business as usual approach. U.S. advantages must be exploited, and science and technology must be more fully utilized. A part of this will include changing procurement attitudes and practices.

Relative to technology, the study noted a number of areas of potentially high pay-off, particularly in electronics and data processing, with their potential impacts on intelligence, communication, and tactics being significant.

The study stressed the need for greater reliance on enhanced capabilities of brilliant weapons (true fire and forget, automated munitions), as well as the need for new materials and concepts to reduce size and weight of the Army's equipment.

The new technical field known as robotics can have an important impact, said the study, on the Army of the 90s through reduced costs, improved quality, reduced manpower requirements, and even increased productivity in areas such as materials handling and in field use to reduce personnel losses in hazardous operations such as mine clearing. The study stressed the potential gains available through laser technology and signal and data processing in electronic warfare. Enhanced use, by the Army, of space in the fields of communication and navigation can offer significant payoffs. Exploitation of U.S. leadership in aircraft design and production could, in the study group's findings, provide a multifold increase in airlift capability, with concurrent personnel savings in combat service support functions, particularly if a heavy lift helicopter (25-30 tons) is developed.

In the life sciences field, the study saw potential mechanisms and processes to develop new vaccines and treatment options for diseases and other battlefield hazards.

(Continued on page 6)

readiness is training," he stated. However, he continued, the high costs of firing our weapons systems are driving us to new dimensions of simulations, which must be realistic and interesting to the individual soldier — the backbone of our defense system.

In conclusion, Secretary Marsh encouraged members of the board to come forward with their ideas and suggestions. "We cannot close our doors or minds to resources of the industrial community . . . we must incorporate new ideas into our research and development . . . those with ideas will have their day in court, and be heard."

Ms. Amoretta Hoeber, Deputy Assistant Secretary of the Army (RDA), addressed the group, on behalf of the Assistant Secretary, noting that the Office of the Assistant Secretary of the Army (RDA) intended to utilize ASB talents and ideas. She then outlined future projects the ASB might consider.

Among these were two concurrent summer studies; protection efforts against chemical, biological, and toxic warfare; and recommendations on how the Army can attract and retain talented science/technical people. Other possible subjects might be a review of the acquisition system, a review of the scope of Army laboratories, laser eye protection, artificial intelligence; and near or mid-term future of robotics.

GEN Donald R. Keith

GEN Donald R. Keith took part in his first ASB membership meeting, since taking command of the U.S. Army Materiel Development and Readiness Command (DARCOM), giving the host command welcome and challenging the Board to assist DARCOM in its mission of designing for production and maintenance, in addition to its efforts in human factors.

GEN Keith summarized DARCOM's planning, programming and budgeting programs and called on the group to assist DARCOM in carrying out transition from planning to production, with the emphasis on more efficient time and costs, as well as a reduction in bureaucracy.

He noted that the tasks that need to be dealt with by the board required cooperation and a team effort, and assured that he would try to create that kind of environment in DARCOM. The General then asked for suggestions and advice and said his office had an open door policy in accepting sound guidance. He also actively participated in answering questions directed to RDA programs, throughout the meeting.

Mr. Norman R. Augustine, former Under Secretary of the Army and Assistant Secretary of the Army for Research and Development, was guest speaker at the banquet held for ASB members and guests.

Dr. Ernest Wilkins Jr.

Dr. J. Ernest Wilkins Jr., deputy general manager, EG & G, Inc., Idaho Falls, bid his farewell as ASB chairman and announced the names of the new chairman, vice-chairman, and new members of the board. Dr. Richard D. Montgomery, director for Corporate Development for R & D Associates, Marina del Rey, CA, is the new chairman; Dr. Wilson K. Talley, professor, Department of Applied Science, University of California (Davis), is vice-chairman.

COL Roger W. Mickelson, ASB executive director, gave the introductory remarks at this meeting, the first of two general meetings held each year. Although this one was held in the Washington area, meetings are normally held at field installations and activities throughout the U.S.

To provide the Board with a frame for their work, CPT C.L. Rees, assistant secretary of the General Staff, DARCOM, briefed the group on DARCOM's organization, missions and responsibilities, through resources and command comparisons with the U.S. Army Forces Command, U.S. Army Training and Doctrine Command, and U.S. Army Europe.

Following an inventory comparison of DARCOM and private industry, CPT Rees gave an overview of DARCOM's R & D commands, including its test and evaluation commands and facilities, corporate laboratories, materiel readiness commands, arsenals and ammunition plants, depot system commands and activities, security assistance center, and other agencies.

Dr. Robert Oswald, technical director of the U.S. Army Electronics R & D Command, gave the briefing for the organization responsible for the RDA of electronics equipment, which enhances the soldier's ability to fight and survive on the modern battlefield.

Dr. Oswald reviewed missions of the Combat Surveillance and Target Acquisition Laboratory, the Electronic Warfare Laboratory, and the Electronics Technology and Devices Laboratory, located at Fort Monmouth, NJ, as well as the Atmospheric Sciences Laboratory at White Sands Missile Range, NM; the Signals Warfare Laboratory at Vint Hills Farms Stations,

VA; and the Night Vision and Electro-Optics Laboratory at Fort Belvoir, VA.

The technical director also summarized Firefinder/REMBASS (Remotely Monitored Battlefield Sensor System), SOTAS (Stand-Off Target Acquisition/Attack System), Night Vision Laboratory-developed common modules, pilot night-vision sensor/target acquisition designation sight, gunner's primary sight for the M1 Abrams, and fuzes for the multiple-launch rocket system, among recent systems either fielded or in development.

He concluded his remarks by citing major technology thrusts that are required in microelectronics; millimeter-wave transmitters, receivers and antennas; electro-optics, radar technology research; atmospheric sciences research for natural and battlefield environments; signal processing; and research in vulnerability and survivability.

COL Theodore Vander Els, commander of the U.S. Army Mobility Equipment R & D Command, briefed the group on major program areas that included mobility/countermobility systems, survivability systems, energy systems and logistics systems.

Countermine leads the field of endeavor in mobility/countermobility. Other fields in this area are counter obstacle/construction equipment; gap crossing/bridging; and obstacles/barriers.

The commander explained MERADCOM's work in field fortifications, camouflage, physical security, tunnel detection, topographic equipment and tactical sensors.

ASB Summer Study

(Continued from page 4)

Additionally, the study continued, human sciences and human engineering can make a major contribution to the Army of the 1900-2000 era by increasing soldier performance and effectiveness. The soldier-machine interface will be a vital factor in future weapon systems.

Without operators and maintainers who can properly execute system functions, the study said, "high leverage technological advances in hardware - the major force equalizer the U.S. is counting on - will be lost." There is a need then, for greater attention in the areas of recruiting, motivation, and training.

However, the study noted with great concern, the stated Army goal of equivalency in 1985 is not likely to be attained, in view of the limited funding provided the Army so far in the 80s, particularly in tech base research and development. Equivalency, let alone superiority in the 1990's, will require "the Army and the Congress to take some extraordinary actions to increase the funding available to the Army."

There has to be adequate funding of R & D, now, the study noted, if the high technology systems, equipment and materials needed in the 1990's are to be attained. Estimates of required additions are in the range of $115-165 million above projected FY82 and FY83 levels.

The group took notice of the great potential that existed through exploitation of the U.S. high technology economy. The cited example was the fast moving semiconductor field where new generations of data processing equipment are coming on the market every two to four years.

In contrast, the Army is taking at least 10-15 years to field systems. Unless changes are made in the Army's acquisition practices, the Army will continually be fielding obsolete equipment, equipment that is almost always bigger, heavier, harder to maintain, and more costly to maintain because of reduced parts availability.

Procurement practices must be tailored to the realities of the U.S. industrial base and civilian economy," particularly with the inadequate industrial reserve and mobilization planning base as it now exists. In light of the probability of a "come-as-you-are-war," the closer the Army is coupled to the commercial economy, the easier it will be to assimilate commercial assets to the war efforts.

The study group praised the Army for the excellent start it has made on long-range planning, particularly through the DARCOM Long-Range RDA Plan, noting it will be an important tool in managing RD & A. However, the group cautioned that patience would be required in making this a truly effective tool as it gradually evolves to maturity.

Concurrent with all of the findings, the Army will have to modify existing doctrine and tactics - even develop new ones, if full advantage is to be taken of modified and new technology.

The study group commented on what it saw as the need for the Army to "consider combining some programs into bigger packages in order to better articulate their needs and to better allocate funds." Air defense systems were cited as an example of such a combination.

The Army, it was also agreed should do all it can to stimulate U.S. science and engineering education, even to the extent of giving scholarships, particularly in light of the growing disparity of U.S. engineering graduates versus Soviet graduates.

Looking ahead at what changes could ensue if technology is fully utilized, the study saw several of considerable magnitude, not the least of which would be a mix of forces equipped with light and agile vehicles. Information availablity decision aids and flow to commanders at all levels would be greatly improved. The Army will be truly equipped and trained to fight around the clock and in all kinds of weather, and in every type of terrain and condition of war.

There are well over 100 specific recommendations in the study. Most of these support the theme of the study: "overcoming the fog of battle for U.S. forces and thickening it for the enemy." This would include early enemy force identification and accurate location; friendly unit position and condition; efficient command and control and soldier-machine decision process; fast, accurate delivery of maneuver forces electronic warfare and munitions; timely and efficient resupply/replacement; and continuous land and air combat capability round the clock and in all weather.

Findings of the study were briefed in detail recently by Dr. O'Neal to Secretary Marsh, General Meyer, the entire Army Science Board, the Army Staff, and to selected senior officials of OSD and the three Services.

In the energy program area, COL Vander Els reviewed command endeavors in electric power, fuels and lubricants, and heaters and air conditioners. Logistics endeavors included water supply, fuels handling, materials handling equipment, marine craft, and railway and utility equipment.

Dr. Phil E. Depoy, director of Operations/Evaluation Group, Center for Naval Analyses, Alexandria, VA (outgoing vice-chairman of the ASB), reported on the principal findings of the ASB on the Design of Army Tests.

Six key findings, which will be incorporated into forthcoming directives and Army regulations, identified by Dr. DePoy, are Documented Audit Trail, Critical Issues, Test Criteria, Differing Objectives of Development Testing and Operational Testing, Coordinated Test Design and Contractor Testing.

MG Laddie L. Stahl (USAR-Ret.) manager of Electronics Systems Program Operations/Electronics Science Engineering, General Electric, Schenectady, NY, presented a discussion on Armor/Antiarmor, reviewing problems and possible solutions; weapon requirements, including unguided and guided hypervelocity rockets; vehicle concepts utilizing robot assist and remote control; and the hypervelocity missile carrier vehicle.

Dr. Donald E. Erwin, member of the technical staff at Bell Laboratories, Holmdell, NJ, spoke on "Simulation of Area Weapons Effect." In discussing Engagement Simulation, he addressed the need for realistic training for combat, while reviewing MILES as a good means of simulation training for direct fire weapons, and appealing for a new method of simulation for indirect fire weapons.

Dr. Erwin stressed the need for simulation techniques that present audible and/or visible signatures. Accurate and timely assessment of casualties was among other factors discussed as important considerations to be given to simulation systems directed to individual and collective training.

The U.S. Army Science Board's 1981 Summer Study on Equipping the Army (1990-2000) was presented by Dr. Russel D. O'Neal, a former Assistant Secretary of the Army (R & D), now a private consultant at Ann Arbor, MI.

In summarizing 23 recommendations of the ASB, Dr. O'Neal said that the 1990s threat is vast, but it can be met through high-leverage technology. The Army system is possible if we use our economy wisely. The Army as a system must be highly information-oriented and target-knowledgeable, and we must develop brilliant weapons that are intent driven. *(For an in-depth review of the Summer Study, see p. 4).*

Dr. Joseph Sternberg, senior staff member of RDA Associates, Arlington, VA, reported on Manning Army Systems, with a focus on near-term issues, outlining the study plan of programs now in development and for new systems that are being introduced.

In comparing the systems selected for study, Dr. Sternberg, who is a former scientific adviser to the Supreme Allied Commander in Europe, compared old and new system functions, such as the M-60 with the M1 Abrams, the Cobra with the AH64, and the Hawk with the Patriot.

Questions requiring consideration include, "Have changes in recruit aptitude score affected the ability to operate and maintain current systems?", and "Are the new systems adding to the people load, compared to the system they replace?"

Mr. Alvin R. Eaton, chairman of the ad hoc subgroup on Testing of Electronic Systems, summarized the Board's recommendations, which called for increased emphasis on early design/testing phases; attention to special needs of software design/testing; consideration of parallelism in test development; more consistent planning of post-DSARC III testing; additional coordination of test facility planning; improved planning for interoperability testing; improved technical continuity and corporate memory.

Other ASB members in attendance were Dr. Arthur J. Alexander, GEN Austin W. Betts (USA-Ret.), Dr. John D. Blair, Dr. Joseph V. Braddock, Dr. William M. Brown, GEN Leonard F. Chapman (USMC-Ret.), Dr. Harold E. Cheatham, Dr. Kenneth E. Clark, Dr. R. Adams Cowley, Dr. Howard C. Curtiss, Jr., and

Dr. Joseph D. Douglass Jr., Dr. K.C. Emerson, Mr. Jerome Freedman, Dr. David L. Fried, Dr. Antoine M. Garibaldi, Mr. Abraham Golub, Dr. Don Navarro Harris, Dr. Wesley L. Harris, Dr. E.O. Hartig, Dr. Richard C. Honey, Dr. Paul W. Kruse Jr., Dr. Robert H. Kupperman, Dr. Richard M Langendorf, and

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DARCOM Realignment Spawns Weapon System Manager Concept

By Roy D. Greene & Dr. James H. Donnelly

The realignment of HQ DARCOM became effective on October 15, 1981. However, an earlier start toward improving DARCOM acquisition management was made on September 15th. On this day, LTG Robert J. Lunn, DARCOM deputy commander for Materiel Development, enthusiastically introduced the new Weapon System Manager (WSM) concept to an audience of project managers and other members of the DARCOM community.

Lunn indicated that there was an immediate need for implementation of the concept, which is an integral element of the HQ DARCOM realignment. As an interim step, the General appointed the PMs for 17 major programs to serve as the WSM for their respective systems. WSM assignments for these PMs will last for approximately six to twelve months; then, at some date, yet to be determined, HQ DARCOM personnel will assume the role of WSMs.

This arrangement is fine you might say but just what is this WSM concept that had to get underway immediately and just how does it affect me? Good questions, since many of us in the Army materiel acquisition community will be affected in the very near future.

HQ DARCOM has been operating under a corporate management philosophy since its AMARC reorganization of 1976. Unfortunately, this corporate philosophy and its underlying decentralization of management placed a severe management strain on planning, directing and controlling multi-billion dollar programs.

The corporate staff was stretched so thin that it was extremely difficult to forecast and respond to the numerous crises that programs experience. It seemed as though each time some issue arose, the field had to be contacted for information - HQ DARCOM just did not have enough knowledgeable people with in-depth information to handle each crisis situation in a professional manner.

This perceived lack of staff depth was underscored by DARCOM Commander GEN Donald R. Keith when he related, during a Commander's Call in September 1981, that "I have to tell you that when I was the Deputy Chief of Staff for Research, Development and Acquisition, the lack of depth in the DARCOM HQ staff, particularly on the RDA side of the house, was a source of frustration."

GEN Keith and his staff were not the only people to recognize that HQ DARCOM had a problem. GEN John R. Guthrie, DARCOM's previous commander, also recognized it, and he directed that a comprehensive study be undertaken to assess the HQ DARCOM situation. After considerable study by a panel of senior HQ DARCOM executives, Guthrie ordered that an extensive realignment be undertaken to improve weapons systems management.

The realignment became effective on October 15, 1981 and it is of such a magnitude that the HQ DARCOM staff will be increased with a significant number of management, technical and administrative personnel. In essence, GEN Guthrie wanted HQ DARCOM back into the management network in a meaningful way - lack of depth must be a thing of the past.

Based upon recommendations made by the senior executive management team, a decision was made to use the effective matrix management organizational structure. The matrix management structure has been used successfully by the aerospace industry for a number of years. The centerpiece for the matrix structure was to be the WSM concept.

In effect, WSMs are to be drawn from each of two newly formed principal directorates, the Directorate for Development, Engineering and Acquisition (DEA) and the Directorate for Supply, Maintenance and Transportation (SMT). The principal role for each WSM is to perform as the single HQ DARCOM authority for each of the systems assigned.

Additionally, the WSM will serve as the single Washington Operations Point for assigned systems. What this means is that the WSM will not only be the focal point in HQ DARCOM but will be the focal point for all DARCOM field elements, e.g., commands and PMs, as well as the focal point for other agencies in the Washington area.

During program execution, the WSM is responsible for review, assessment and status reporting for system cost, schedule and technical performance and readiness. Other responsibilities include representing HQ DARCOM in formulating, justifying, defending and assuring the proper execution of assigned systems. However, as LTG Lunn has emphatically pointed out several times," . . . the PM is still the PM . . . we are just trying to present a unified position."

The purpose of the WSMs is not to preempt the PMs but to strengthen their position and voice in the Washington area. In a broader sense, WSMs will serve as Washington area management liaisons who can be of immeasurable assistance to PMs.

Operationally, WSMs will be drawn from either the DEA or SMT Directorate for systems assignments. Each system assignment will depend upon the acquisition life cycle stage for that particular system. For current and future systems, WSM control will be transitioned from DEA to SMT depend-

ing upon the technical maturity of the system subsequent to completion of full-scale engineering development.

Each WSM is expected to have extensive system knowledge for each assigned system, a formidable task, hence, the need for matrix management. Each WSM will be assigned a team of technical, analytical and legal experts drawn from the various functional and staff elements at HQ DARCOM. This team of experts will provide the knowledge base required for in-depth system understanding.

Specifically, team members or Weapon System Support Officers (WSSOs), will be drawn from the offices of DEA, SMT, Procurement and Production, Product Assurance, Command Counsel, Comptroller, etc. Under the matrix management concept, each will be organizationally assigned to functional staff elements but also serve as knowledgeable experts on the WSM's team. In fact, a special name has been given to these teams - Weapon System Management Teams (WSMaTs). Each system designated for intensive management will have an assigned WSMaT at HQ DARCOM.

It is anticipated that the WSMs, plus supporting WSSOs, will provide the necessary manpower amplification factor to make in-depth HQ DARCOM systems management a reality. As LTG H.F. Hardin, Jr., DARCOM deputy commander for Materiel Readiness, has recently noted "Matrix management should allow us to be more responsive, not only to the Department of the Army, Congress, and the public, but equally, if not more important, it should permit us to improve support for our soldiers in the field."

A short example of how the matrix management concept will operate, theoretically applied to Integrated Logistics Support (ILS), may be helpful to the reader at this time. An ILS WSSO, who organizationally is formally attached to the SMT Directorate, would be assigned to the X-System WSMaT as the ILS member.

Let us assume that System X is currently entering full-scale engineering development. Since it is in development, the WSM has been assigned from the DEA Directorate. Under the matrix management concept, a sample of the activities that the ILS WSSO must be involved in, participate in, and influence relative to System X are: work statements for ILS in requests for quotes; structure of ILS elements in program management plans; assessment of contractual logistics support analysis plans and execution; detail review of logistics support analysis reports; review of logistics support demonstrations including physical teardown and evaluation; and design reviews.

In addition to the aforementioned, the ILS WSSO is still expected to meet the specialized work requirements of his functional directorate. As can be seen, the traditional management axiom that no man can serve two masters has been violated. However, given the past high level of adaptability exhibited by the HQ DARCOM staff, this violation will not present an insurmountable barrier.

DARCOM management has high expectations for the WSM concept. The WSMaT is expected to be ready to respond to all system acquisition questions on a real-time basis. If the PMs have to be contacted for information each time new questions arise, the WSMaT is at the threshold of failure. This knowledge requirement is extremely demanding and will require an extensive data base for team members to draw upon.

Planning for an extensive data base has been going on during the past several months. The first significant product of this planning has been the Program and Cost Control System (PCCS) which was implemented recently. The PCCS will provide WSMaTs with up-to-date program cost schedule and technical performance information for several major and non-major weapons systems. Eventually, all systems will fall under the PCCS or a derivative of it, e.g., an abbreviated form of the PCCS may be used for less complex systems.

In addition to PCCS information, other information that will be on-hand for WSMaT use will include such documents as: development and production contracts, special contract clauses, royalties and licensing agreements, date rights, system specifications, and the coordinated test plan.

In the very near future, people in the field will find that the HQ DARCOM staff will have a new and very active interest in such activities as design reviews, test planning meetings, program reviews, quality and production readiness reviews, etc. Members of the WSMaTs are expected to attend key reviews to gain information first hand and, perhaps, even participate with field personnel as review team members in their area of specialty.

During the next few months the biggest problem for PMs will be to educate WSMaTs. The biggest problem for WSMaTs will be to acquire in-depth knowledge of their systems at an accelerated pace.

Thus far, 17 systems have been designated for intensive weapon system management. These are: M1 Abrams Tank System, Patriot Air Defense System, U.S. Roland, Advanced Helicopter Improvement Program, Advanced Attack Helicopter, Hellfire, Viper, Fighting Vehicle Systems, SOTAS, Copperhead, M60 Tanks, Black Hawk, Cobra, Single Channel Ground and Airborne Radio Subsystem, Division Air Defense Gun, Test Measurement and Diagnostic Systems and the Remotely Piloted Vehicles/Drone System.

Currently, the PM for each system is performing as the WSM and the WSSOs are being drawn from project office staff with the exception of one WSSO on each team. The exception is a member of the HQ DARCOM staff who is serving as a team member for training and coordination purposes.

Fourteen HQ DARCOM Personnel have been identified as WSSOs and assigned to specific systems. Additional systems will be identified for weapon system management during FY82. Also during FY82, HQ DARCOM personnel will be identified as WSMs and WSSOs.

In order to accelerate the learning process, a complete WSMaT will be formed at HQ DARCOM to staff manage a system on a pilot basis.

This team will develop WSMaT doctrine, protocol, procedures and methodology for use by other future WSMaTs.

Also, in order to simulate actual management crisis situations, the Principal Assistant Deputy for Materiel Development will chair in-house systems reviews for the purpose of evaluating the ability of the WSMaT to cope with critical review of their system. The WSMaT will be expected to present and defend their system with minimal support from the system project office and its PM.

During the upcoming months, additional systems will be placed under the WSM concept. The rate of additions will be influenced by how fast HQ DARCOM can staff-up its WSMaTs. All major systems will definitely be under weapon system management and many urgently needed non-major systems will also be included.

Also, during the next few months, a vigorous effort will be underway to release a new document, DARCOM Memorandum No. ____, Weapon Systems Management - HQ DARCOM Concept of Operations. This memorandum will provide essential policy and methodology guidance for DARCOM personnel for efficient and effective management of the acquisition process.

Eventually, all DARCOM systems will be under the WSM concept. All complex systems will have a one-on-one dedicated WSM, while other less complex systems will fall collectively under one WSM. In either case, there will be a HQ DARCOM WSM name and telephone number for each system.

This headquarters acquisition responsibility will place a heavy burden on the WSM and WSSO team members. However, the power and flexibility of matrix management is expected to make the job achievable. On the other hand, as more and more Washington area work is shifted toward DARCOM, this should allow the PMs and their staff to concentrate on their primary mission - the development and fielding of reliable, cost effective systems.

Much work remains to be accomplished. A WSM management information system must be designed, implemented, loaded with documentation and updated. People must be hired and trained, and system knowledge must be transferred from project management staff to HQ DARCOM staff. Also, DA, OSD and Congress must be convinced that the WSM can handle most of their inquiries on a real-time basis. The success of this effort will depend heavily on the PMs and their staff and their ability to transfer knowledge to the HQ DARCOM WSMaTs.

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The Evolution of Specialty Code 51

By MAJ Brendan P. Blackwell

For all those active duty "green suiters" who hold the SC 51 research and development management specialty, significant changes are coming in the career field. The overall goal of the changes is to increase research, development, *and acquisition* experience and career field expertise. This will be accomplished by more clearly identifying jobs that contribute to development of career skills and by providing for more intensified career field management than that which now exists.

The current environment that includes the Project Management Development Program (PMDP) and the current SC 51 R & D management field and other specialties, does not assure that our career field objectives can be accomplished. Now, with several years experience under the Officer Personnel Management System (OPMS) behind us, evolutionary developments are necessary to better meet both the needs of the Army and the commissioned officers who serve in SC 51.

As part of a 1980 Chief of Staff Army review of materiel acquisition, attention was focused on improving program execution with emphasis on the production and fielding phases of the acquisition process. It might be asked: . . . with PMDP and SC 51 R & D management career fields, what more is needed and why? The answers are varied and extensive in scope.

The Army had moved into the largest peacetime modernization program in history with over 400 systems being fielded over the next several years. Furthermore, the largest portion of the Department of Defense discretionary budget is represented by the investment accounts of R & D and acquisition. These accounts are subject to the closest scrutiny by Congress and the dollars involved exceed $70B for the 83-87 modernization program.

Another dimension of the modernization challenge concerns the range of complexity of the weapons systems

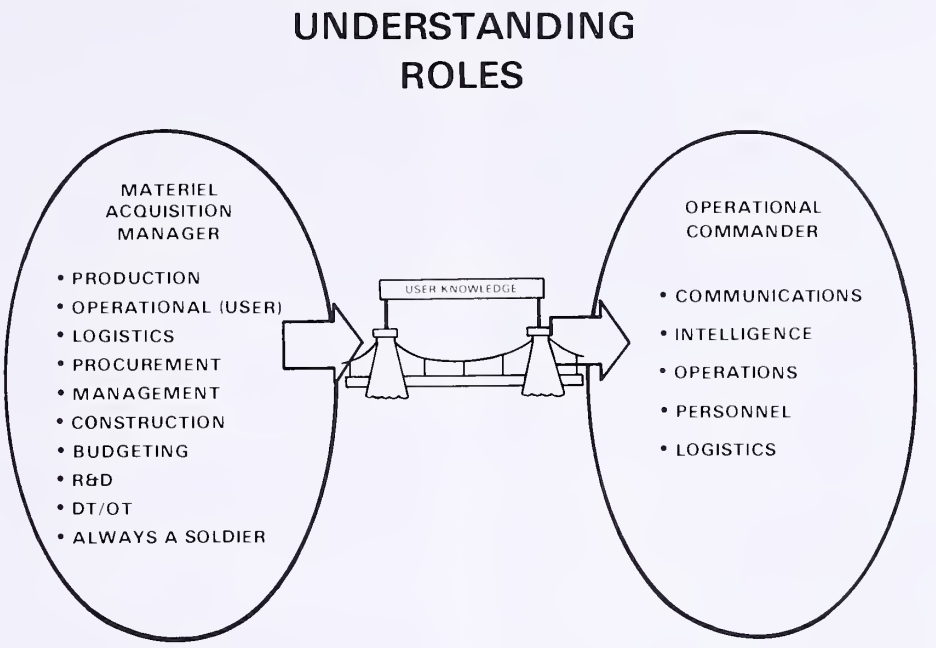

Figure 1

entering production and fielding which extends from new uniforms to M1 Abrams main battle tanks and integrated tactical communications networks. The rate of change in our fighting force and its equipment is accelerating and likely to be with us for many years.

Because all weapons systems are so different, the management process through which new systems must "pass", must be tailored to accomplish specified program goals. All of the reasons presented here serve to stress that officers who are assigned materiel acquisition management jobs must not only be personally competent, but well versed in the career field by virtue of education and experience.

General Keith (the new commander of DARCOM) is personally committed to the improvement of the management of resources. His commitment was initially manifested when, as the Deputy Chief of Staff for Research, Development and Acquisition (DCSRDA), he convened a Materiel Acquisition Management Career Field Assessment Team that worked under the direct supervision of his ADCSRDA (then MG Merryman who is now the current DCSRDA). LTG Merryman is equally strongly committed to this SC 51 evolutionary program.

GEN Keith's guidance required the assessment team to define a meaningful career specialty that would produce officers broadly developed in the many disciplines inherent in the task of developing, procuring, and fielding weapons systems and equipment. He further suggested that the effort may necessitate redesign of the career field, entry requirements, educational requirements, assignment patterns and the career field itself.

The assessment team, headed by an ODCSRDA officer, LTC (P) Ken Ingram, included representatives of MILPERCEN, ODCSPER, and HQ DARCOM. In June 1981, the results of the career field review were presented to General Officer representatives of the participating agencies.

The primary problem identified by the assessment team was that the

materiel acquisition management career field was not adequately defined *and consequently* there was no appropriate career management. The assessment team looked at the role of materiel acquisition managers, i.e., what they were doing and where organizationally they performed their jobs, examined current personnel management approaches to see if they defined a career field, and lastly, examined the type of professional development experiences that were considered desirable for a member of the career field. This approach yielded an estimated statement of the needs of the Army and enabled the assessment team to describe personnel management and specialty proponent initiatives that would strengthen the members of the materiel acquisition management career field.

Figure 1 is a simplified comparison of the role of the materiel acquisition manager compared with that of an operational commander. Within the two elipses are listed representative areas within which officers must have a degree of professional competence in order to provide nominal assurances of success. Because the two disciplines are so different and because a "dual track" is essential to bridge the "developer" to "user" gap, the assessment team concluded that the materiel acquisition manager must have a firm foundation in education and experience in *two* specialties: one which qualifies him operationally and the other which specifically prepares him for materiel acquisition management. And, GEN Keith has continually stressed the need to assure that "operational command or expertise" applies to officers of all branches.

A strong knowledge of operations is fundamental to success in materiel acquisition management if we are to put the best possible equipment in the hands of the soldier. Accordingly, the materiel acquisition manager must gain mastery of an extensive list of areas of professional expertise.

It became dramatically apparent that officers who wish to pursue materiel acquisition management must be intensively managed to assure that job and schooling assignments contributed to the development of expertise germaine to either or both designated specialties.

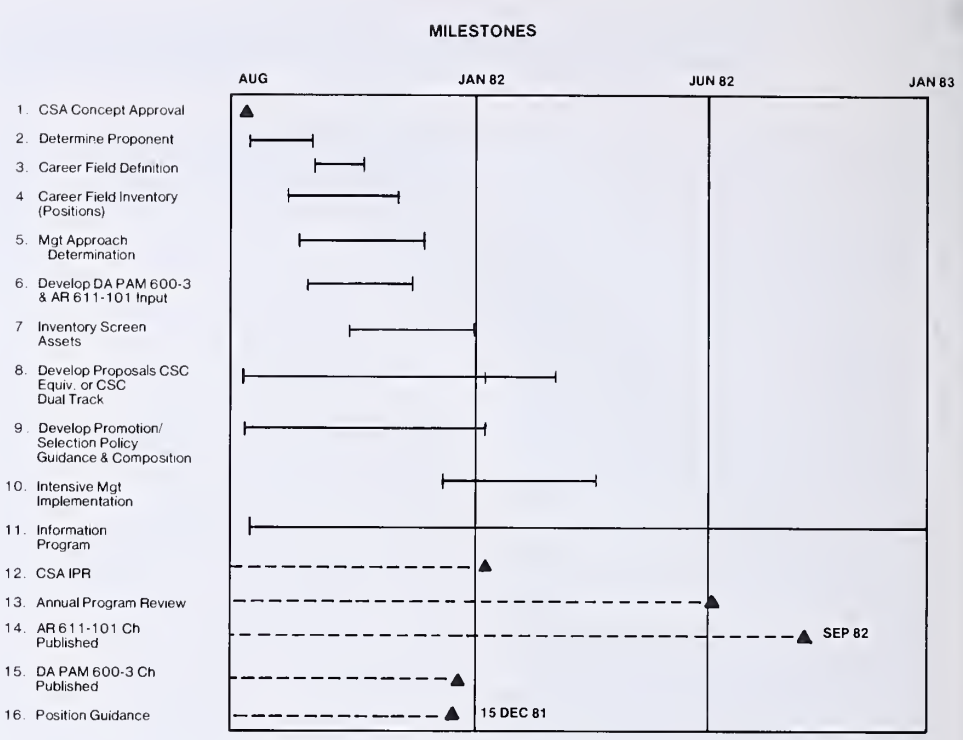

Figure 2

The assessment team reviewed both the current SC 51 and the Project Management Development Program as potential personnel management "umbrellas" under which the materiel acquisition management career field might fit.

SC 51 was selected because it offered the best possibility for connecting the key materiel acquisition management jobs to a personnel management approach that offered the best starting point from which a more intensive management approach could be tailored. In actuality, the jobs were much more broadly oriented than the current definition of SC 51. Accordingly, SC 51 will be redefined to include *all* aspects of acquisition.

The PMDP program was rejected as a definitional tool. PMDP, by design, is a *developmental* program for an officer population oriented on project management which is a subset of all materiel acquisition management jobs. PMDP has represented within it, 35 specialties and a greater variety of specialty mixes among its numbers.

The kind of intensive management needed by the materiel acquisition management career field would be difficult to achieve using a "PMDP-like" approach. PMDP further, was never designed to relate job requirements to personnel as evidenced by the fact that there were about 1,300 PMDP members and over 1,500 developmental positions.

The assessment team found that, whereas approximately 150 colonels were in the acquisition management business, fewer than one-third this number were project managers (PMs). There are also about 45 General Officers in the acquisition management field and fewer than one-seventh of this number are PMs.

Several aspects of PMDP represented good first steps toward improving materiel acquisition management and the assessment brought about by PMDP should be transferred to the newly defined SC 51 as well as the formal training opportunities/emphasis. The selection and tracking methods are also applicable.

The assessment team proceeded to look at the kinds of professional development the materiel acquisition manager should experience and to

search for criteria for tailoring a personnel management approach that might support such a development track. Further, a professional development milestone was selected to act as a baseline from which one could judge feasibility. DODD 5000.23, "Materiel Acquisition Management Career Fields," yielded milestone criteria adaptable for Army use.

In addition to operational experience and traditional professional development experiences (initial entry specialty experience, branch schooling, SCS, etc.), the assessment team determined that the materiel acquisition manager should have completed two materiel acquisition assignments and the Defense Systems Management College by the 15th year of service. Thus, at that point, he or she would be fully qualified to undertake an 05 command *or* a key materiel acquisition management assignment having the highest order decision making authority.

Is it possible to manage a professional development scheme with such a crowded menu? The answer is a *"yes"* from the leadership of the agencies participating in the assessment team.

Full qualification in two specialties, which includes two materiel acquisition management assignments by the 15th year of service, advanced civil schooling, specialty training, and CSC or the equivalent, is achievable. This goal can be accomplished by identifying candidates for the career field while they are lieutenants, with entry into SC 51 not later than the 6th year (rather than 8th year or later) and intensification of career management.

On 17 August 1981, the Chief of Staff, Army approved implementation of a program to intensify management of Army officers in the materiel acquisiton management career field.

The milestone chart shown in Figure 2 represents the major activities to be accomplished to implement the revised SC 51 along with an approximate phasing of the activities. As the implementation process proceeds, more information will be forthcoming concerning the details and duration of a transition period for the members of the new career field.

HQ DARCOM, the new proponent for SC 51, will redefine SC 51 to broaden its scope and provide additional focus on the final phases of the materiel acquisition process, i.e., production and fielding. The name of SC 51 will also be changed from research and development to materiel acquisition management. Additionally, the DARCOM commander will, along with MILPERCEN, review the jobs in the materiel acquisition community in order to develop a more meaningful career structure.

MILPERCEN will develop and implement an intensive personnel management approach which will provide better professional development of commissioned officers in both an initial specialty and the SC 51 materiel acquisition management specialty. This will entail minimizing nonspecialty related assignments for materiel acquisition managers while maximizing opportunities to assign members of SC 51 to jobs which support dual tracking. The goal is to achieve desired SC 51 professional experience levels by the 15th year of service and make full use of available training opportunities.

In connection with career field training requirements, the Defense Systems Management College (DSMC) curriculum will be reviewed in connection with CSC to see how best the members of the revised SC 51 could make use of the courses offered. The goal is to make maximum use of the DSMC curriculum given the reality of the Combined Arms Service Staff School (CAS3) and the CSC long course.

For those who only attend CAS3, the DSMC 20-week course may best meet career field requirements. For those who attend CSC, it may be possible to "import" the DSMC curriculum for the elective phase. In any case, the assessment team believed that DSMC was essential for the professional development of *all* materiel acquisition managers.

While these evolutionary changes to OPMS will produce more highly specialized officers in the materiel acquisition management field, they will also provide considerable broadening within the field. The changes should better enable the participants to manage modernization in the accelerating environment of change where new and improved weapons systems are being fielded in support of the largest Army modernization program in peacetime history.

This is the first of several articles to be run in this magazine dealing with the revitalization of the materiel acquisition management field. Future articles will include those actions being taken regarding reservists who hold materiel acquisition-type assignments and also how the civilian career field for this area is to be strengthened.

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ORSA Conferees Examine Key Army Challenges

Significant applications of operations research and systems analysis techniques for solving potential Army problems were reviewed by military and civilian representatives from the U.S. and abroad during the 20th U.S. Army Operations Research Symposium at Fort Lee, VA.

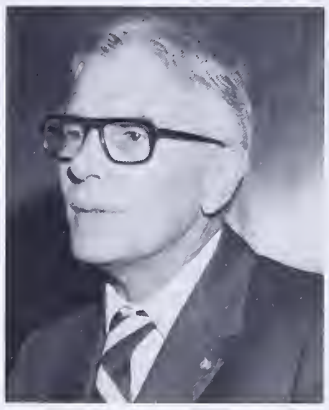
Sponsored by the U.S. Army Materiel Development and Readiness Command, the meeting was cohosted for the eighth consecutive year by the U.S. Army Logistics Center, the U.S. Army Logistics Management Center, and the U.S. Army Quartermaster Center and Fort Lee. This year's theme was "Army OR — Supporting the Process of Rational Choice for the Army Today and Tomorrow."

The objective of the Army Operations Research Symposium is to provide a stimulating forum for the Army's ORSA community relative to the needs of both the user and the analyst. Arrangements for this year's meeting were made by the U.S. Army Materiel Systems Analysis Activity, Aberdeen, Proving Ground, MD.

Symposium chairman Mr. Keith A. Myers, director of AMSAA, provided welcoming remarks and called the meeting to order. He asked the attendees to participate fully in discussions in order to get the full benefit of the symposium.

Deputy Under Secretary of the Army (Operations Research) Mr. Walter W. Hollis began the formal presentations with a keynote address on his perceptions of the Army operations research community. He initially asked the question: Why do we have the Army operations research symposium? He answered by stating that he believed they were held to expose the work of new Army analysts to the senior analysts. He said that senior analysts had an obligation to help those who were new to the field.

The deputy under secretary then posed the question — Is Army analysis healthy? This, he responded, depends on where you sit. It depends upon your perception. He noted that there are some real imperfections in the Army analysis field. One which is very serious,



Mr. Walter W. Hollis

he continued, is the failure to look at the wealth of rich data derived from tests in the field.

Hollis told his audience that they needed to generate more requirements for data. He added that they represented the real backbone of Army analysis.

Deputy Under Secretary Hollis closed his remarks by stating that the important thing to Army analysis is that the analyst does responsible work, and that management continues to search for the truth.

MG Robert L. Bergquist, DARCOM deputy commander for Resources and Management, followed Deputy Under Secretary Hollis with a "fast-paced" slide report on the recently completed Army Logistics Study. He began by emphasizing that this Army study, directed by the Army Chief of Staff, was the first Army logistics study since 1965.

Bergquist indicated that the study

MG Robert L. Bergquist

team was directed to look at current logistics deficiencies and to look forward to the year 2,000. Although his ORSA presentation dealt only with the "Force Modernization" portion of the Army Logistics Study, Bergquist said that the entire study consists of 3,000 charts plus text. He stressed that the study could actually be used as a text manual.

No one in the Army today is really looking at the entire force modernization effort, noted Bergquist. This is surprising, he said, because force modernization is one of the central issues and complex challenges facing the Army.

The General said that in addition to supporting the new equipment introduced into the Army, it is important to emphasize the maintenance of old systems. He added that integrated logistics support is really the foundation of good logistics support, and that logistics support analysis is the strength of ILS. Said Bergquist: "Early ILS must be guided by logistics concepts and long-range doctrine."

Bergquist maintained that ILS requirements must be integrated into "total system requirements." If ILS is not considered early in the development process then the negative impacts are numerous.

The Army depot system must become more involved at an earlier stage in the total ILS effort for weapon systems, said Bergquist. He added that the depots will have to increase their support to the field Army and provide counseling to contractors on quality deficiencies. He predicted an increasingly important role for the depots in the 1990's.

The General cited the following recommendations relative to the force modernization portion of the Army Logistics Study: a single manager for force modernization should be designated; ILS should be improved; stabilize the requirements determination process; control cost growth; and develop a time-phased plan to improve production expertise.

Banquet speaker Dr. Robert Carney,

professor of management at the Georgia Institute of Technology, provided a lively presentation on "What the Textbooks Don't Tell You About Management." He began by stating that there are too many people teaching management today who have probably never managed anything.

Carney noted that the big emphasis in management today is how to improve the individual's quality of life. This is nonsense, he said. He stressed that the most important task is to concern yourself with management, not with psychological tasks.

Dr. Carney maintained that the Japanese don't bother with management training like the U.S. If the Japanese have a problem, they put the manager right in the middle of the problem, not in an isolated office. Said he: "We have to get back to managing people in relation to the job to be performed, not human factors." Today's typical manager spends 70 percent of their time outside of their department, said Carney.

The term workalcoholic, continued Carney, is wrongly used in a negative context. Workalcoholics are just as happy as the person who only works 40 hours a week. There is absolutely nothing wrong with being a workalcoholic if the person is happy.

Carney added that if a person isn't doing a good job then they should be fired — not counseled. He noted that today's managers worry too much about an employee's happiness instead of their productivity.

According to Carney, the U.S. is only 1 of 9 civilizations that have lasted 200 years. Those that have gone under had certain things in common, such as being overly critical of business and the military. This, he said, is what led to the downfall of the Greek civilization.

Three factors which have been present in nations lasting more than 200 years, stated Carney, are a strong belief in national institutions, a strong family unit, and a strong system of structural authority.

COL John D. Robinson, director of the Army Model Improvement Program (AMIP) Office at Fort Leavenworth, KS, presented an in-depth review of the AMIP effort. He stated at the outset that he believed that the AMIP was one of the most misunderstood programs. It doesn't embody all Army Modeling, but is a development process limited to the construction of three models.

Robinson noted that there is a very broad requirement for analysis in the Army, and that the AMIP is concerned with model hierarchy from the individual soldier to theater level analysis. He then posed the question: How do I manage the AMIP? He responded by saying that his office looks at all the processes that occur on the battlefield, and then determines if we are dealing with the battalion, corps or theatre level.

U.S. Army Training and Doctrine Command schools and centers and the people who provide data to the AMIP Office are critical to the operation of the AMIP, said Robinson. He added that his office not only studies the enemy's operations and doctrine, but what may be going on in their minds.

Robinson indicated that some of the key priorities of the Army Model Improvement Program are: to support the Army's analytical mission; to develop functional area representations; to develop unit effectiveness measures; to develop data base management; to design simulations up to theater and corps level; and to develop red and blue presentations.

Deputy Assistant Secretary of the Army (R & D) Ms. Amoretta Hoeber followed COL Robinson with a discussion on the Soviet threat factor and the role of threat analysis. She introduced her topic by saying that there is a great need to pay more attention to the threat area because of changing conditions.

Ms. Amoretta Hoeber

Ms. Hoeber appealed to her audience to take a closer look at Soviet concepts and doctrine. We often ignore it because it is hard to draw conclusions from Soviet materials, she noted. We also assume that Soviet doctrine changes too often to be believed. However, she continued, Soviet doctrine really doesn't vary much. In fact, she added, they are more consistent than we are!

Suprise and superiority are two areas of the Soviet philosophy toward which we *must* give more emphasis, explained Hoeber. She stressed that the U.S. relies too much on waiting until a war begins to develop concepts. The Soviets don't wait! The Soviet's have a 2-pronged effort — what they do for themselves, and what they do to us.

Relative to superiority, Ms. Hoeber stated that it is a key objective of the Soviets. Their view, however is different from ours. We look at superiority in terms of numbers, she said, while they look at command and control, reconnaissance, and survivability. They also strongly consider the impact of a "first strike.".

Other factors the Soviet's look at, according to Ms. Hoeber, are battle management and leadership capability. Leadership, however, is not viewed by the Soviets in a static sense. They are more realistic about what a person will do in a particular situation.

Deputy Assistant Secretary Hoeber also stressed that the Soviets also differ from us in their view on escalation of war. They do not believe that use of nuclear weapons is the primary escalation point. Instead, they believe that attack of their homeland is the real point of escalation.

The U.S., on the other hand, sometimes espouses a concept of not attacking Soviet command and control because we believe we will need it to negotiate. The Soviets, however, will destroy our command and control because it represents our capitalist society.

Ms. Hoeber concluded her presentation by stating her belief that the Soviets have a strong desire for political domination. However, she said, they are not in a big hurry to achieve it. She called on the ORSA community

to develop better threat analysis methodology, and to take a closer look at Soviet misinformation and devise better ways to combat it.

One of this year's most highly informative R & D presentations at the symposium — A Comparative Evaluation of the Military Worth of Mine Neutralization Systems — was provided by CPT Bradley L. Jolliff from the Countermine Mobility Laboratory, U.S. Army Mobility Equipment R & D Command.

Among the various mine neutralization devices reported on by CPT Jolliff were mine rollers and plows, the surface launched unit fuel-air explosive, and the vehicle magnetic signature duplicator. He noted that the factors which are considered in developing a mine neutralization device are availability (logistics); capability (what is the area to be cleared?); and dependability (what type of environment will it be used in?).

CPT Jolliff emphasized that no single device can serve all mine neutralization needs. However, during the battle, mine neutralization devices will definitely be used, both in an offensive and a defensive role.

The final general session speakers, MAJ John D. French from the U.S. Army Military Personnel Center, and COL Arvid West Jr., from the U.S. Army Combined Arms Studies and Analysis Activity, discussed "Specialty 49 (Operations Research) Demographics."

They explained that no one can enter the Army with a 49 specialty code. Operations research/systems analysis is a late entry specialty. Also discussed were the various courses available to 49 specialty personnel. These include degree programs at the Florida Institute of Technology, Air Force Institute of Technology, Georgia Tech, and the Naval Post Graduate School, and ORSA refresher courses.

In addition to general session presentations, this year's symposium included eight special sessions devoted to contributed technical papers and informal discussions. Titles and chairmen of the special sessions were: *Sustainability and Support to Forces in the Field,* Mr. David H. Gilbert, AMSAA; *Command, Control, Communications and Intelligence Systems,* Mr. Gale R. Mathiasen, U.S. Army TRADOC Systems Analysis Activity; *Force Effectiveness and Survivability,* Mr. Arend H. Reid, AMSAA; *Testing and Field Exercises,* Dr. D.W. Collier, TRADOC Combined Arms Test Activity; *Manpower, Training, and Personnel Management,* Dr. H.S. West III, HQDA; *Recent Advances in Operations Research Methodology,* Dr. Robert Launer, ARO; *Force Modernization,* LTC Luther Woods, Army Force Modernization Office; and *Force Design Planning and Programming,* COL Gene Welch, U.S. Army Concepts Analysis Agency.

A new feature at this year's symposium was an awards ceremony honoring the presenter of the "best" special session paper, and the individual and group recipients of the recently instituted Annual Army Systems Analysis Award.

Mr. Charles E. Todd

The best paper award, consisting of a plaque, a certificate, and a monetary stipend, was presented to Mr. Charles E. Todd for his paper on "Command, Control and Evaluation Methodology Development Task Force." Todd is a supervisory operations research analyst at the Army TRADOC Systems Analysis Activity. His paper was selected in competition from among 90 others.

The Annual Systems Analysis Award, which was established under the sponsorship of the Deputy Under Secretary of the Army (Operations Research), is intended to provide recognition to DA civilian and military personnel for achievements in the application of operations research and systems analysis to the solution of significant Army problems.

This year's individual winner, Mr. Alan J. Kaplan, from the U.S. Army Inventory Research Office, was cited for his achievements in developing and implementing a series of models that are now widely used throughout DARCOM in the initial provisioning of weapon systems.

Group recipients of the Systems Analysis Award were MAJ John Andrighetti and Mr. Charles F. Horton from the Operational Test and Evaluation Agency. They were recognized for their achievements in solving a problem related to the Firefinder Artillery Locating Radar (TPQ-37). Specifically, they provided an innovative 3-step analysis using box plots, cluster analysis and map-like display to aid in a production decision on the Firefinder.

GROUP WINNERS of Army Systems Analysis Award MAJ John Andrighetti and Charles F. Horton flank MG Robert L. Kirwan, OTEA commander.

A Challenge to Maintenance Engineering . . .

Helicopter Battle Damage Repair

By Richard L. Scharpf and John Ariano

The helicopter has proved to be a viable and lethal weapon system in addition to being rugged and survivable. It moved from a secondary role on the battlefield to a dominant role over the past decade, but this dominance was only achieved as a result of nearly total air superiority over the opposing forces.

The only threat to the helicopter was antiaircraft weaponry of varying caliber and mobility. It is anticipated, though, that this threat will increase in quantity as well as in mobility and that the lethality will continue to rise. The small caliber air defense weapon with its high volume will most probably be accompanied by medium caliber weapons with high lethality.

Additionally, a new threat which the Army helicopter will have to face will be from air-to-air encounters. Massive armor movements will be heavily supported by tracked and wheeled air defense units, tactical aircraft, and by formidable armed helicopters equipped with small and medium caliber weapons. Surface-to-air and air-to-air missiles can also be expected any time a helicopter approaches or penetrates the Forward Edge of the Battle Area (FEBA).

To meet the anticipated increase in threat, the U.S. Army Aviation Research and Development Command's Applied Technology Laboratory (ATL), Fort Eustis, VA, is undertaking an interesting new technology effort toward achieving an improved combat maintenance capability for Army aviation.

Even though the aforementioned threat will cause extensive damage to aircraft, it is certain that a significant number of our helicopters will return from an encounter with the enemy with varying degrees of battle damage which may or may not preclude the helicopters from being available for another mission.

In some cases, repairs may not be necessary as long as the helicopter is still found to be capable of providing the needed firepower to slow down or stop massed enemy tank forces. On the other hand, a severely damaged helicopter must be repaired as rapidly as possible so that additional sorties can be accomplished.

Only through maximum availability of the attack helicopter can the ground commander exploit all possibilities to make the enemy pay dearly for each foot of ground he seeks to obtain. Flexibility for rapid deployment of the firepower of the attack helicopter during the first week(s) of combat operation can only be achieved through an aggressive R & D effort in the area of maintenance technology.

Results of the structural and the shape memory alloy (SMA) development efforts conducted at ATL and numerous discussions within the Army aviation community caused the Battle Damage Repair (BDR) program to be restructured to accommodate the recommendations from previous efforts and to include new ideas and concepts. A shift in emphasis relative to component and subsystem repair as well as restructuring of the program took place.

The Lab's helicopter battle damage repair program objective has not changed and remains the same in its emphasis to develop inspection criteria, repair techniques, maintenance support concepts, and a design methodology that will permit greater deferrability/repairability of battle damage and reduce maintenance requirements on future helicopters.

Discussions held with USAF counterparts, Canadian Forces personnel, and with others have resulted in assumptions in regard to possible operational issues that are being identified as drivers and requirements for some of the R & D programs. These issues are called our 3Ms; that is methodology, material, and manpower, a triad of interdependent activities of the program.

The methodology issue addresses actions required of our maintenance personnel after a damaged helicopter lands or is possibly retrieved. The damage must be located and described, an assessment has to be made relative to the severity of the damage, and finally, restoration of strength is required. The most critical issue is that of assessing the damage.

The current fleet of metal aircraft can sustain severe damage to the primary structure and survive. The level of repair required to restore full operational capability necessitates knowledge of the structure, of the available repair techniques, and of the adequacy of the strength following repair. The assessor may elect not to have repairs made because he knows that the damaged structure can sustain all operational loads provided that the hours of flight operation do not go beyond an established limit.

One of the criterion which Advanced Technology Laboratory is developing is the decision for "Defer A." This decision implies that the assessor determined that the airframe is able to continue unlimited combat for at least 100 hours. Only cosmetic repairs may be necessary, if at all.

"Defer B" is identical to "Defer A" except that the crashworthiness/survivability is sufficiently degraded so that serious injury or loss of the aircraft would occur if hit again. A "Defer B" decision may be necessary only during the most intensive combat situations.

The assessor will be provided with sufficient knowledge relative to combat serviceability of all systems, subsystems, and the structure to enable him to make a 1-time flight decision. A 1-time flight means that the damaged aircraft will be capable of controlled flight to a repair facility, however, the speed/maneuvering envelope may be severely restricted.

A major goal of the Lab's efforts is to permit unlimited combat operation for 100 plus hours after any repair is made. All viable repair concepts are and will be analyzed relative to this capability.

One issue which has not been addressed to date is the problem of restoration of the aircraft after numerous battle damage repairs are made and after the high-surge condition is over. It is expected, though, that the National Guard Aviation Classification Repair Activity Depot (AVCRAD) units will have the capability for restoration of damaged aircraft.

It must be assumed that supply during the initial combat surge will be limited to what was ordered prior to the surge and to what was on hand. HBDR peculiar stockage may become a reality if ATL's efforts are successful relative to development of HBDR kits.

These kits will be developed along the lines of the USAF's aircraft battle damage repair kits in order to prevent duplication of effort.

At the present time, it is comtemplated that special kits will be developed for hydraulics, electrical, and structural repairs, and that these kits will be issued in a sealed manner to prevent pilferage of items prior to usage.

Sheet metal, angle aluminum, bar stock, rivets, adhesives and tapes, and special tools would constitute a structural repair kit. These special tools may include high-speed air-driven saws capable of rapidly cutting sheet metal, honeycomb panels, and composite materials.

Cannibalization of parts is recognized as a means for achieving an improved availability. During a surge, it is envisioned that reconstitution of three helicopters out of five may become a necessity. As a result, special cannibalization techniques and tools will be investigated and/or developed.

The goal of the Army's HBDR effort is to develop criteria, methods, and techniques which will permit a rapid return of battle damaged aircraft to combat ready status. The requirement for speed and efficiency led us to assess elapsed repair time as a means for driving novel repair ideas to the forefront. Discussions with British, Canadian, and USAF counterparts have resulted in formulating the following elapsed repair time targets for total system repair:

- Aviation unit maintenance - mean time to repair (MTTR) = 5 hours; maximum time to repair = 8 hours

- Aviation intermediate maintenance - maximum time to repair = 24 hours. The 24 hours maximum time to repair for AVIM matches the maximum time to repair of 24 hours at organizational level of the USAF.

Training for HBDR and specialization is being addressed by TRADOC. As techniques are being developed and proven acceptable, training of personnel will follow. As previously mentioned, assessment of damage is one of the most important aspects of the HBDR activity and it is envisioned that specialization of assessors will result.

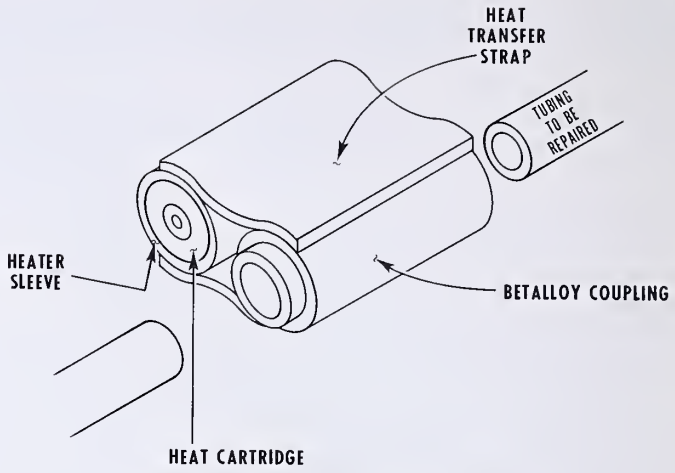
Responsibilities of the assessors will be great, since their decisions will have a profound impact on combat availability of aircraft as well as on logistics. The assessors' accurate determination as to the time required for repair impacts whether an aircraft is repaired at AVUM, AVIM, or whether or not it becomes a parts bin is indicative of this responsibility.

An assessor has to have knowledge of the various subsystems on the aircraft, available fault isolation methods, as well as an intimate understanding of the repair techniques that need to be compiled by the maintenance personnel.

Also as previously stated, the assessor needs to understand the capabilities and limitations of each repair action and particularly, if new repair has to be added to an already damaged aircraft. It is clear that the assessor will play a major role in the Army HBDR capability.

The three issues described above assisted in formulating the specifications and requirements for ATL's current and future R & D programs in HBDR. The following is a general discussion of various programs and is intended only to generate interest and to solicit comments.

Two previous efforts on structural repairs and inspection have formed that basis for the follow-on effort entitled "Structural



Repair Coupling With Heat Cartridge

Inspection and Repair Guide." One contractor will be selected to develop a guide for use by the Army. A handbook will be generated by the same contractor using this guide. This guide then will form the baseline for handbooks for the current fleet of helicopters and will also be used for a design methodology for future helicopters.

As the current metal airframe fleet will benefit from the current composite material research program in regard to repair concepts, so will the future composite airframe fleet benefit from the lessons learned from the work on the current fleet. The key word is maintainability under combat situations.

Repair of the metal airframe is relatively easy to accomplish with techniques and tools already available at some level of maintenance.

In contrast, repair of composite airframe components has not been introduced into the Army system except for the ATL developed rotor repair concept. New ideas will require development, therefore, such as the modular construction technique for the composite fuselage. This technique has already been identified as having a high payoff because of the considerable reduction in repair time for normal (peacetime) and combat operations.

Also, introduction of dyes into the composite materials could help identify the primary structure should damage from a threat cause exposure of the underlying structure. Color coding would be of great help to the assessor.

Capabilities of the shape memory allow (SMA) will continue to be assessed and developed for rapid repair of fluid lines, flight controls and drive shafts. New designs are envisioned (see photo above) that will further enhance the maintenance personnel's ability to make rapid and effective repairs. New heaters will be investigated and tested.

Most of the serviceability criteria were developed by the contractor during design and development of his helicopter. The criteria are usually based on safety aspects and, as a result, the limits established are extremely conservative. Certain wear limits are known to have no bearing on safe, continued operation of the helicopter provided that the combat surge does not exceed 100 plus hours of operation. An investigation into these limits will be conducted and a guide developed.

Electrical wiring may be the most frequent candidate for battle damage repair for recoverable and repairable helicopters. As the

electronics package grows in size, so will the frequency of hit on the electrical system increase. Although it is difficult to assign an exact magnitude to the workload, data shows that wiring is difficult and time consuming to repair.

In addition, as the high explosive threat increases, damage from projectile fragments and other small particles will cause great difficulty in fault isolation and troubleshooting. Automatic test equipment and other ground support equipment designed to aid in fault isolation may not be available at AVUM during a surge or it may not be usable because the maintenance personnel do not have sufficient skill in its operation.

As previously stated under operational issues, the ability to accurately assess battle damage and to make the repair decisions is a critical skill which will require development. If our assumption is valid, for every five severely damaged helicopters, three will be reconstituted. In order to keep the time required for this reconstitution at an absolute minimum, optimum strategies will be developed for efficient and effective cannibalization of components and airframe parts. Tools may need to be developed for AVUM use or for use by contact teams to rapidly break down any damaged helicopter which has been declared to be a parts bin.

Lessons learned from the individual efforts will be used toward developing a HBDR design methodology for future Army helicopters, that is, it is the intent of this effort to include maximum inspectability/repairability and deferrability of combat inflicted damage into all future designs.

Prior year efforts in survivability and crashworthiness have resulted in a design philosophy which has already paid handsome dividends on the current fleet of advanced helicopters. The HBDR design methodology will be a logical extension of the crashworthiness/survivability efforts. Initiation of this final phase of ATL's HBDR work will occur in fiscal year 84 and it is expected that the results can be incorporated into the LHX/LAH/LUX family of helicopters in fiscal year 86.

It is obvious that technically elegant repair techniques will not increase the Army's combat capability if these techniques require intensive and specialized training by our maintenance personnel. It is the goal of the R & M team of ATL to assess each concept and method developed relative to the capabilities of the maintenance personnel, logistics impact, and cost.

In addition, because repair of many subsystems is involved, a repair time sensitivity analysis is being initiated to assist the Lab in developing more realistic requirements for elapsed repair times. A model was obtained from the Canadian Forces-Europe and which was modified for our use. This model will be used to establish realistic subsystem repair times in order to achieve an optimum sortie rate.

It is envisioned that subsystem repair difficulties expressed as a time element will highlight further R & D needs. Extensive coordination is being affected with members of TRADOC/T-School, the logistics community and with tri-Service personnel.

In addition, ATL's work is being monitored by the NATO members of EUROLOG charged with surveying the battle damage repair program of the NATO countries. The objective of this extensive coordination is to prevent any duplication of effort. It is considered imperative that the philosophy of HBDR be introduced into all Army curriculum, especially in view of the fact that some of the NATO members of the USAF have schools already established for their personnel and assessors.

It must be recognized that the HBDR philosophy and concept applies only for combat operations and specifically for a surge condition. A problem may be the documentation of battle damage repair actions from the cannibalization and possible repair concepts mentioned. It is suggested that the current documentation procedures be reviewed and streamlined to meet the specific demands of a surge condition and permit some degree of traceability.

The helicopter battle damage repair (HBDR) program discussed herein constitutes a major R & D program undertaken by the Applied Technology Laboratory (AVRADCOM), Fort Eustis, VA. The program is believed to meet the needs of the modern Army as has been evidenced by the favorable feedback received. It is also clearly understood that this R & D program cannot stand alone and will require extensive and dedicated participation by all members of the Army aviation community.

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JOHN ARIANO is an aerospace engineer at the ATL, U.S. Army Research and Technology Laboratories. He received a BS degree in aircraft maintenance engineering technology from Northrop Institute of Technology and an associate in applied science in aircraft maintenance technology from the Academy of Aeronautics. He serves as a project engineer for exploratory and advanced development programs in the area of maintenance technology for current and future aircraft systems.

'Vetronics' — A New Approach to Vehicle Electronics Integration

By Dr. Ernest N. Petrick, Donald S. Sarna & COL Thomas Huber

The "explosive" expansion in electronics technology is rapidly being introduced into combat vehicles to provide unprecedented capability and versatility. Vehicle electrical/electronic system complexity is also expanding due to greater demands for electrical power and data transfer. It is time, therefore, for a more efficient method of vehicle electrical/electronic system integration.

In order to better focus attention on this topic, the term "vetronics" has been coined at the U.S. Army Tank-Automotive Command. Vetronics encompasses the total integration of vehicle electronics similar to the term avionics used in aircraft, but including also the electrical power system. Todays' ground combat vehicle has reached a level of sophistication approaching that of an aircraft.

The growth in electronics applications in the combat vehicle has resulted from requirements placed on the vehicle and crew to do more under a wider variety of hostile conditions. As the versatility and capability of the vehicle has expanded, so has the complexity of the electrical/electronic system due in part to traditional combat vehicle design practices.

Many high technology subsystems are developed independently by a variety of agencies and contractors (i.e., radios, range finders, thermal sights, weapons systems, engine controls, etc.). In addition, the new combat vehicle requirement generally utilizes some subsystems previously developed for other applications.

The prime vehicle contractor then in effect patches together the many subsystems available from these different sources. The process results in a pseudo-system integration with wiring harnesses tieing the systems together by brute force, rather than an efficient, totally integratable system capable of accommodating a variety of subsystems with the potential for modular replacement and technological upgrading.

As the number of subsystems increases, it is clear that a more efficient form of integration is required. Optimum design includes a multiplexed bus power and data distribution and control system capable of integrating all systems with a significant reduction in wiring system complexity.

In order to better visualize the vehicle integration concept, a good analogy can be made to the perfect model for integration study - the human body (Figure 1). The brain is analogous to the human crew coupled with the on-board computer; the nervous system resembles the multiplexed data bus; the cardiovascular system is equivalent to the electrical power distribution bus system; and the vehicle subsystems are analogous to the body organs.

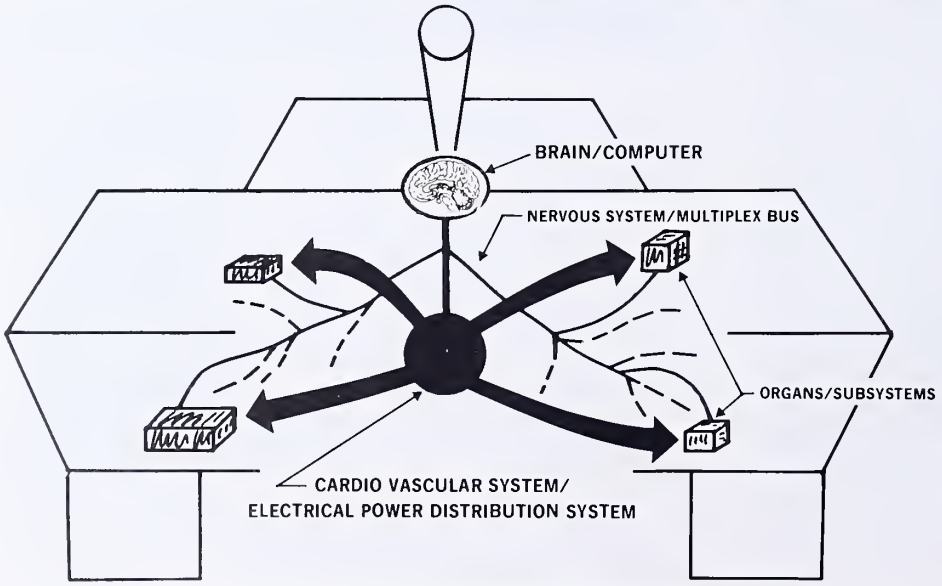


Fig. 1. Vetronics: Electrical/Electronic System Integration

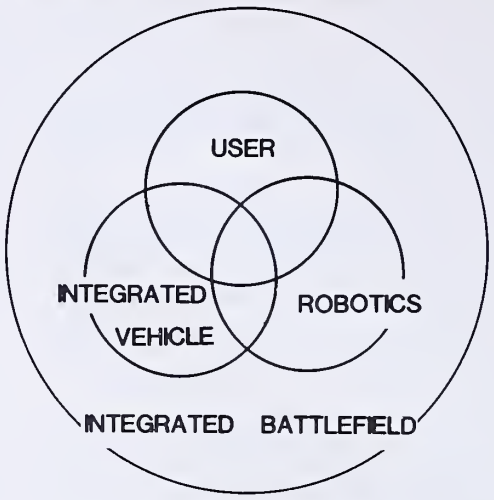


Fig. 2. Total System Integration

The integrated system visualized here opens the door to operation in a new dimension. In effect, the vehicle contains a "smart system using micro-processors, tied to a central control and power distribution system. It monitors and communicates with its own subsystem. The vehicle also could communicate with the outside environment and perform select automatic functions without crew intervention (robotics).

Perhaps more significantly, the door would be opened to operation on the future automated battlefield. The vehicle could enter into a two-way interchange of information within the integrated battlefield and be capable of performing some robotic actions.

Future battlefields will be rich in sophisticated weapon systems providing high lethality, high mobility and an expanded kill zone. Consequently, for some battlefield situations, there will need to be a change in tactics. This change, as expressed by TRADOC, can be compared to the difference between a football team and a soccer team.

The football team huddles together after each play to call the next move; frequently the coach sends in the play. By contrast, each member of the soccer team knows the objective at the start of the game and operates individually within the combined team to achieve that objective.

There is no time to huddle. Translating this to the future battlefield, each combined team member will need to be able to operate individually to achieve the predetermined.

Elements of the total system are depicted in Figure 2. The system consists of the user, integrated vehicle and robotics, all closely tied together and immersed in the integrated battlefield environment. The most important element is the user, the vehicle crewman who inherently is the most

intelligent part of the system due to his ability to learn and adapt to the circumstances.

The integrated vehicle's ability to communicate with the battlefield and automatically perform select robotic functions will enable the crew to focus on surviving and destroying the enemy.

Information normally displayed to the crew will be selectively limited to that essential for mission accomplishment. For example, it is conceivable that a real-time graphic display of the battlefield can be provided to the individual fighting members to optimize the combined team effectiveness.

Total integration of the vehicle into the future electronics intense battlefield is the objective of vetronics. It will be necessary to define carefully the on-vehicle nerve center and power distribution system to enable effective integration of future subsystems and the ability to communicate electronically with the integrated battlefield. In addition to the integrated battlefield dimension, on-vehicle electronics integrations will provide a multiplicity of benefits to the vehicle and crew:

- First level diagnosis of failed systems
- Prognostic capability
- Integrated crew controls and displays
- Robotics potential
- Improved electrical system reliability
- Field replacement/survivability of power/data busses
- Flexibility for electrical/electronic system modification and upgrading
- Reduced system volume and weight

Integration of the electrical/electronic system is not a panacea. However, it will provide the potential and opportunity for some dramatic improvements in combat vehicles.

A multiplexing concept for application to combat vehicles is presently in early development. The system acronym is ATEPS (Advanced Techniques for Electrical Power Management, Control and Distribution Systems). A unique feature of this system is control of both power distribution and data transfer.

Power and data are bussed within a shielded conduit system looped within the hull. A prototype system is presently being installed in an M1 hull for demonstration and initial concept tests in early 1982. The concept is being expanded to the turret to demonstrate gun stabilization functions.

A parallel effort is directed toward application of modern sensor technology to provide a sensory subsystem with capabilities analogous to the human senses of sight, hearing and touch. Integration of data from these sensors may make it possible to identify threats and locate targets.

This information in turn can be used to alert the crew or to initiate action by the vehicle to defeat the threat. Integration of the sensory subsystem and the resultant reaction would be accomplished via the vehicle multiplex system as illustrated in Figure 3.

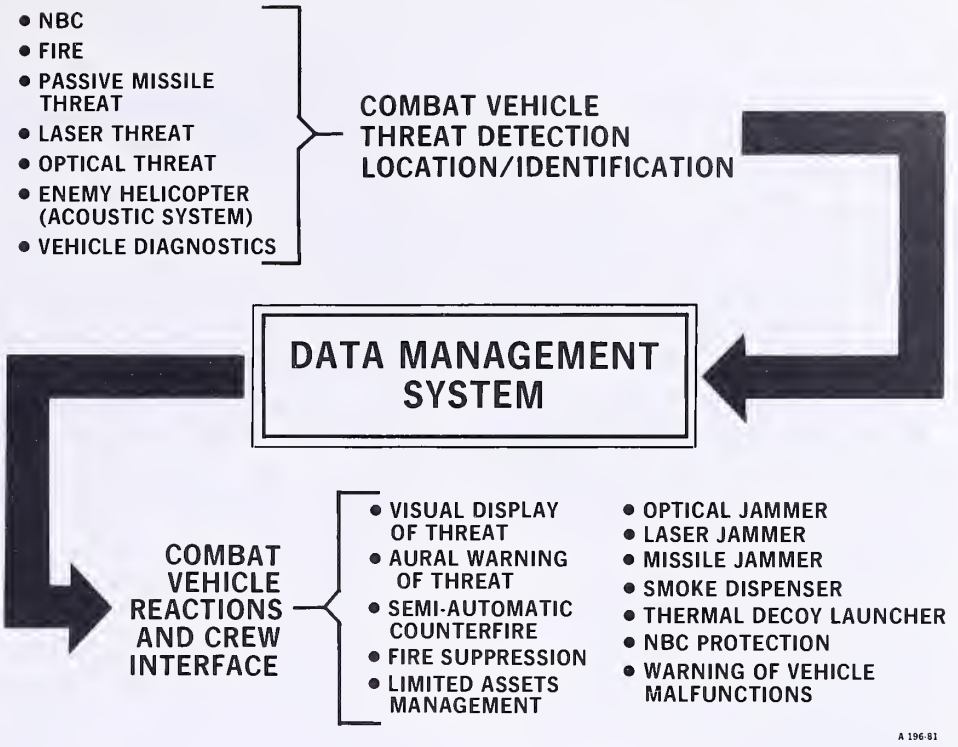


Figure 3.

Opportunities for increasing the crew's capabilities within a fully integrated combat vehicle, as described above, involve the full spectrum of technologies available in numerous Army laboratories and other government and contractor facilities. A reasoned approach will be required to insure the optimum combination of these technologies.

In order to assist in the early evaluation of new concepts, plans have been made to go through a shakedown phase of test hardware and crew system interface reactions utilizing the TACOM full-scale vehicle simulation laboratory. This will be especially beneficial in establishing requirements to enhance the man-machine interface and to identify needs for robotics.

The facility enables testing of the whole vehicle under controlled conditions. The vehicle can be subjected to any terrain at any speed through facility computer control of hydraulic actuators located under the vehicle suspension elements. The effect, for example, of a newly developed fire control unit on first round hit probability, can be determined in the all-up vehicle configuration in the laboratory.

In addition to providing lower cost testing, the greatest benefit derived is control of test conditions which generally are not accurately defined or controllable during field tests. Full-scale simulation will be a precursor to the use of mock-up and surrogate vehicles in field tests, and the evaluation of concept vehicles by the user. This will result in a better product delivered for such tests.

Combat vehicles continue to be a centerpiece of land combat. Each generation of combat vehicles increases significantly in sophistication and capability; this trend will continue. The future battlefield will be electronically sophisticated, highly lethal and extended in depth.

Electronics and sensing capabilities will provide a new dimension in capability not previously available. It is essential that the future combat vehicle be designed and integrated to participate in this new dimension as a part of the combined arms team on the integrated battlefield. This vehicle electronics integration design concept has been titled "vetronics".

ABOUT THE AUTHORS:

All of the authors are employees at the U.S. Army Tank-Automotive Command, Warren, MI. Dr. Ernest N. Petrick is technical director of the R & D Center; Donald S. Sarna is a weapon systems manager for Diagnostic and Electrical Systems; and COL Thomas H. Huber is director of the Tank-Automotive Concepts Laboratory.

Vehicle Prognostics

By Joseph A. Sraj

How would you like to have a car equipped with a system that would allow you by a mere glance at the instrument panel display to determine the car's overall condition and whether or not a failure is imminent?

Such a system does not yet exist, and you probably won't be able to buy one for the family car anytime soon. But for the field soldier the age of vehicle-failure prognosis may not be too many years away.

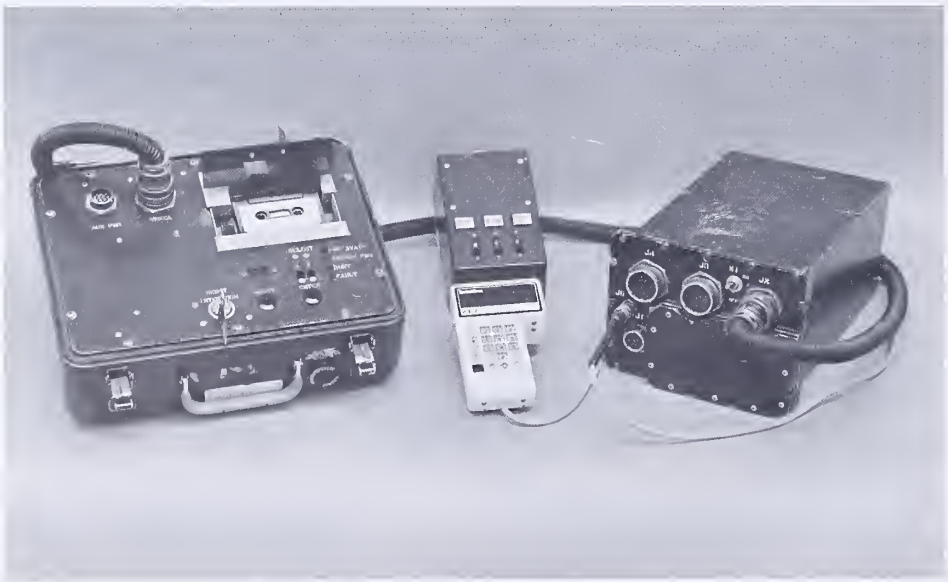
A long-term research project is now underway aimed at developing the technology needed to build a vehicle system capable of detecting early warning signs of malfunctions and accurately forecasting when they will occur.

The project started as a joint effort involving TACOM, and the Defense Advanced Research Projects Agency (ARPA), a Department of Defense agency which pursues research projects beneficial to all U.S. armed forces and the National Aeronautics and Space Administration. In January 1976, ARPA officials met with representatives of the Army and 19 private firms to discuss ways of identifying factors which describe patterns of vehicle use, abuse and overall condition, and to explain the relationship of these patterns to the high cost of vehicle maintenance.

Following that meeting, eight companies submitted proposals for competitive design studies for a flexible research system that would monitor and record information on vehicle use, condition and maintenance actions. In May 1976, two of the eight firms — RCA and Rockwell International — were each awarded a 13-week competitive design study contract.

In September of that year RCA received a two and a half-year development contract to build one prototype system, called the Vehicle Monitoring System (VMS). The contract also called for modification of an M35A2 2-1/2 ton cargo truck and an M113A1 armored personnel carrier with special wiring harnesses and other hardware needed for attaching the VMS.

The VMS was completed in September 1978. It consisted basically of a unit called the Vehicle Monitoring System Electronics Assembly (VMSEA), which is mounted inside the vehicle. The VMSEA contains data-recording equipment and a microcomputer programmed to tell the VMSEA which vehicle type it is monitoring, as well as how often to monitor vehicle measurements, how to process, store and display the data.



COMPONENTS of Vehicle Monitoring System: From left — Data Retrieval Unit; Maintenance Action Indicator, with Set Communicator in foreground; and the Vehicle Monitoring Systems Electronics Assembly.

Two other VMS components are not part of the vehicle installation, but are brought to the vehicle and plugged into the system to perform special tasks. These include a Data-Retrieval Unit, which records data from the VMSEA on magnetic tape cassettes for long-term storage and transfer to a data analysis computer. It also reprograms the VMSEA when it is installed on another vehicle.

The second component is the Maintenance Action Indicator. This is a simple box which a mechanic can plug into the system and enter all maintenance actions performed on the vehicle into the VMSEA data bank.

The M35A2 and M113A1, modified by the addition of special VMS transducers and harness, underwent six months of testing at the Aberdeen Proving Ground between September 1978 and March 1979. It was during this test that engineers found evidence that by expanding the VMS to include additional types of data, the system could have prognostic potential.

Thus, early in 1979 TACOM embarked on what was planned as an 11 year program to develop a prognostics capability, and in May of that year awarded RCA an 18-month contract calling for modification of the M35A2 truck, the computer program software and the VMSEA.

Modifications included the addition of a Set Communicator. This is a hand-held instrument that plugs into the system and allows the vehicle crew to monitor the VMS to make sure it is operating properly and that all desired data are entering the system. It also displays prognostic trend information and allows visual presentation of stored vehicle operation data.

Also added was a design change that allows the VMS to connect to the vehicle-mounted Diagnostic Connector

Assembly (DCA) that is used with the newly developed Simplified Test Equipment for Internal Combustion Engines (STE/ICE) now being fielded. This will enable engineers to determine if engine performance data obtainable through the DCA could have a prognostic application.

Another change was the modification of the computer program to allow the vehicle driver to be notified through a visual alarm — a flashing alpha numeric display — on the set communicator if a problem develops in certain key vehicle areas.

Additionally, new data-reduction techniques were incorporated which are intended to give the VMS the capability of making prognosis concerning the condition of the vehicle battery, battery-charging system, air filter, water pump and fuel economy. These prognostic algorithms predict failure using a trend analysis approach.

Calculations are performed to determine the rate of change of a parameter. When the projection of the trend line intersects the predetermined "fail limit", failure is predicted. Initial fail limits are set low to verify algorithm operation. Adjustments are made when test data are available.

Brake lining prognosis is based on the "geriometric" approach. Geriometry is defined as the monitoring and accumulation of real time stress history of a component to provide an assessment of remaining life.

This information can be used for anticipatory maintenance by replacement of brake lining before total wear out to prevent brake drum damage (secondary failure). Brake pedal travel is monitored to track and predict the need for brake lining replacement.

A successful prognostic program will result in improved vehicle availability (by reduction downtime); reduce maintenance costs (by minimizing secondary failures); provide the unit commander knowledge of his vehicle(s) condition and increase the vehicle operators confidence in his vehicle by predicting failures.

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Robotic Vehicles Aid in Breaching Antitank Minefield

Mine neutralization equipment being developed and tested by MERADCOM was used recently in the Army's first field test of a robotic counter-obstacle vehicle. The test, conducted at Fort Knox, KY, demonstrated the Army's ability to breach an antitank minefield with an unmanned, remotely controlled system.

A modified M60A2 tank chassis was fitted with a mine clearing roller, a Marine Corps M58A1 mine clearing line charge, and a Clear Lane Marking System (CLAMS). An M114 armored personnel carrier was also outfitted with remote control systems for the test.

The two vehicles, operated remotely by personnel located a mile from the site, were used in a simulated combat scenario. Observers had detected enemy minefield laying operations and the robot vehicles were dispatched to counter the threat.

The armored personnel carrier was used to attack the enemy position and draw suppressive fire while the counter-obstacle vehicle cleared a path through the minefield.

The counter-obstacle vehicle located the boundary of the enemy minefield by using the mine clearing roller to detonate one of the mines. It then backed up and breached the minefield by projecting the rocket propelled mine-clearing line charge.

After clearing a path, the vehicle marked the safe lane as it moved through the minefield. When the cleared path was marked, the armored personnel carrier safely followed the counter-obstacle vehicle across the minefield.

COUNTER-OBSTACLE VEHICLE — Modified M60A2 tank chassis, fitted with a mine-clearing roller, a Marine Corps M58A1 mine-clearing line charge, and a Clear Lane Marking System (CLAMS) that marks safe lanes breached by the system.

Lightweight **Tow Bars**

By Roger R. Smith and Jim Boblenz

The U.S. Army Tank-Automotive Command (TACOM) is testing a new lightweight tow bar to replace the heavy, bulky, and cumbersome medium-duty tow bar used to recover all combat vehicles and tactical trucks in the 10-ton category and over. This is the tow bar carried on the M578 and M88A1 recovery vehicles.

TACOM, in September 1979, embarked on a program to design a new lightweight tow bar that would be as strong, efficient and durable as the old one and easier to handle.

The major problem with the current tow bar is its weight, about 340 pounds. It is not only hard to hook up, it is hard to get off the recovery vehicle. It is a four-man operation to man-handle it from the height of over four feet to get it off a recovery vehicle and connect the two vehicles together.

In addition to being heavy, the legs are so long they can get caught in the towing vehicle's track when making sharp turns. This will bend or twist the legs.

Also, the clevises and end fittings have close tolerances with the tow lugs on the towed vehicle. If a leg is bent or twisted, the end fittings cannot be aligned.

Two design approaches were investigated. TACOM's Tank-Automative System Laboratory concentrated on material replacement while the Engineering Support Directorate concentrated on designing a lightweight steel tow bar with improved geometry and no detachable end fittings.

The Lab, in September 1979, awarded a contract to Exxon Corp., to use alternate materials and design a medium-duty tow bar weighing about 125 pounds, light enough for two men to handle, but with the same performance characteristics as the current heavy and cumbersome all-metal tow bar. Space age plastics were used. A composite of materials — kevlar, epoxy, graphite, special adhesives and steel — was also used.

These materials combined to offer high directional strength-to-weight ratio, increased stiffness and low machining costs. Exxon produced and sent to TACOM two tow bars weighing only 125 pounds each that were exactly the same size, and could do the same job as the 340-pound all-steel tow bar.

The composite tow bar uses standard, but redesigned metal end clevises and towing lunette. The legs are made of strong composite materials. Kevlar is wrapped around a steel mandrel and cured. When the mandrel is removed, a hollow tube remains. The outer shell, or sheath, is the protective tube for the high-strength inner material.

The inside tube is made of graphite/epoxy compound. This material is inserted into the outer sheath, expanded against the shell by an inflatable innertube, and cured. After the innertube is removed, the composite tube ends are ground to size. Then the clevis ends and the lunette are glued in place with the adhesives.

Exxon's version of the composite prototype tow bar was delivered to TACOM in December of 1980 and is currently being field tested.

Simultaneously, TACOM's Engineering Design Division of the Engineering Support Directorate began work on designing a lightweight steel tow bar with improved geometry and no detachable end fittings.

One of the problem areas on the conventional tow bar is the end fittings. They not only weigh a great deal, but they are expensive, and they impose bending stresses on the tow bar legs.

On the old tow bar, the geometry is such that the legs will not accomodate different width tow lugs found on various combat vehicles with the same efficiency. On one vehicle the legs will be in tension and compression while on another the geometry will be such that some of the legs will be in bending.

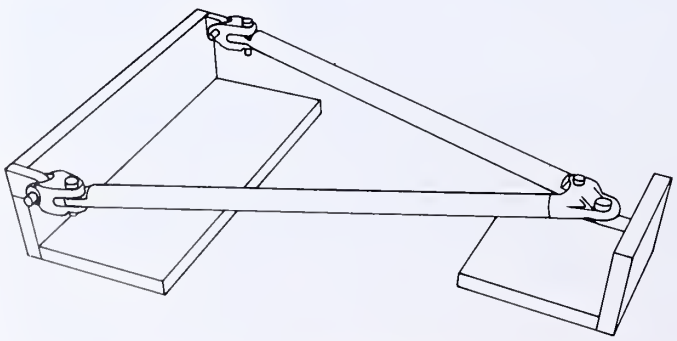
In trying to have all pinned connections and to eliminate the geometry problem, a design was evolved incorporating a set of two separate tow bars exactly alike. The 2-piece steel tow bar has shorter legs, about 72 inches compared to the 83-1/2-inches for the current bar.

Now, when the towing vehicle makes a sharp turn, the track will make contact with the hull of the towed vehicle rather than the tow bar leg.

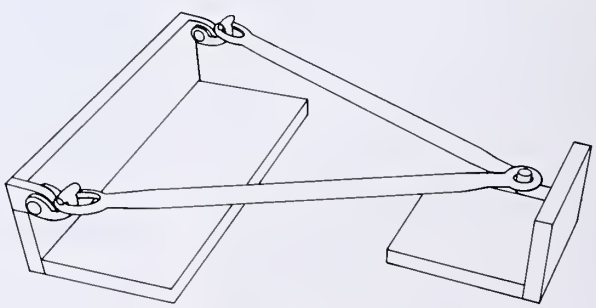
The lunette, which is a doughnut-shaped connection, is a NATO requirement. It is heavy and bulky. Two lunettes will not fit in one pintle — unless the pintle is changed. The only viable solution here was to actually split the lunette in half, perpendicular to its axis. This makes a bagel-shaped ring with sufficient strength to tow a 50-60 ton load.

The other end, the part that connects to the towed vehicle, caused the greatest problem. The difficulty here was to design a connection that would put the towing forces directly through the towing lug. The clevis connection was not considered because it puts an offset on the towing forces, and it is heavy.

An oblong ring similar to that used on the towing cable was finally selected. Users simply connect the tow bar end to the existing tow hooks that are on the tanks. No tools are needed.



Composite Lightweight Tow Bar



Steel Lightweight Tow Bar

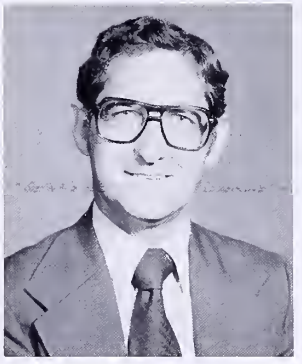
The lightweight steel tow bar consists of two identical bars, each weighing only 60 pounds. This is a 65 percent weight reduction. Stockage and storage of repair parts will be reduced from five to one, the tow bar itself.

The original design was completed in early 1980 and the stress analysis testing was completed in May of that year. Two tow bar sets (4 bars) were completed in March of this year and sent, along with the composite bars, to Aberdeen Proving Ground for field testing.

The reason for designing both lightweight tow bars is two-fold. If both are successful at the conclusion of the testing, the Army has a choice between the two. If only one tow bar version comes out successful, the Army still has a lightweight tow bar.

Also, depending upon the outcome, the two technologies could be combined to reduce the material weight even further. By combining the steel tow bar's end fittings, the concept of two 1-piece bars, and the tube material of the composite tow bar, a 2-piece tow bar weighing only 48-pounds (24 pounds per bar) could be a reality.

The Army benefits in several ways. Weight reduction for battlefield equipment is viewed as necessary and desirable. A lightweight tow bar will be less difficult to handle. It can be hooked up in less time by fewer people, and when not in use, it can be carried on the vehicle wherever it goes, increasing towing capability.



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JIM BOBLENZ is assigned to the Technical Data Division of the Engineering Support Directorate, R & D Center, U.S. Army Tank-Automative Command (TACOM), Warren, MI. He earned a BLS at the University of Oklahoma in 1972 and an MA in industrial management at Central Michigan University in 1973. Boblenz joined TACOM's R & D Center in March, 1981, after serving five years as staff writer and Detroit bureau chief for the PREVENTIVE MAINTENANCE monthly magazine.

Army/NASA Test Crashworthiness of Attack Helicopter

The Army/NASA recently crashed a full-scale experimental attack helicopter (YAH-63) to test its crashworthiness. The U.S. Army Aviation Research and Development Command's Applied Technology Laboratory (ATL), Fort Eustis, VA, one of four laboratories of the U.S. Army Research and Technology Laboratories, conducted the test at the Impact Dynamics Research Facility, NASA-Langley Research Center, Hampton, VA.

The helicopter, released from a height of 59.3 feet, was to impact the ground with a 50-feet-per-second (34 mph) resultant velocity vector. The swing drop method was used with cables separating pyrotechnically just prior to impact. This provided a means to achieve the desired vertical and horizontal impact velocities.

The crash was designed to simulate a 95th percentile potentially survivable condition. Various sensors throughout the helicopter and 19 on-board and external cameras recorded crash accelerations, loads and structural deformations to provide over 80 channels of data.

"The initial test results reveal that the impact pulse was about 15 percent greater than the 95th percentile target," said Mr. Kent Smith, ATL project engineer. "The impact velocity appears to have been in the range of 58-feet-per-second resultant velocity vector as opposed to the expected 50. This resulted in higher loads being transmitted to both crewmen."

Preliminary data shows that about 68 'G's were transmitted to the copilot/gunner seat mounts, but the crashworthy seats reduced the loads to a more tolerable level. However, it will take months to analyze the data to determine the actual survivability of the crash.

Smith said the dynamic behavior of the airframe closely matched that predicted by the pre-test mathematical model. "Also, all of the high mass items (transmission and both engines) remained secured in their mounts throughout the crash; this is essential so as not to pose a threat to the crew," he added.

Special attention was focused on the front seat (copilot/gunner), which was occupied by a human-like test dummy wearing a prototype version of a new design crew restraint system called the Inflatable Body and Head Restraint System (IBAHRS). This system uses a crash impact sensor to trigger and inflate air bags sewn into the shoulder straps.

The air bags distribute the crash loads more evenly over the torso, tighten the shoulder straps, and reduce the chances of the dummy impacting the cockpit structure. The rear seat test dummy was wearing a conventional 5-belt Army restraint for comparison purposes.

The front seat dummy was wearing a flight helmet that is the prototype version of a new Army helmet, the Integrated Helmet and Display Sight System (IHADSS). The helmet with its Heads-up Display Unit (HDU) is designed to project flight and target information directly in front of the crewman's eyes.

In addition to restraint systems and crashworthy crew seats, this Army attack helicopter uses a variety of other systems to increase its energy absorption capability and thus bring the crash loads to the crew within human tolerance limits. The landing gear, belly structure, crew seats, and restraint system are all part of the latest crashworthy technology.

Other crash protection devices being tested on-board include a new Navy Deployable Flight Incident Recorder/Crash Position Locator (FIR/CPL) and several versions NASA improved Emergency Locator Transmitters (ELT) which are used to locate downed general aviation light aircraft.

The full-scale crash test of the YAH-63 was the 41st in a series begun by the Army in the early 1960's. The YAH-63 aircraft was manufactured by Bell Helicopter Textron and was that company's candidate in the Army's Advanced Helicopter (AAH) competition during the mid 1970's. ATL acquired the YAH-63 as residual hardware following the AAH competition.

WES Investigating Water Jet Device For Repairing Bomb-Damaged Concrete

How effective is a water jet in repairing bomb damaged concrete airfield runways? This is a question posed in an investigative project at the U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

The runway repair effort is part of the military funded Rapid Repair and Restoration of Paved Surfaces Project. One of the objectives is to use a water jet to cut out the bomb damaged areas before replacing the concrete. Although current repair methods using a diamond-tipped concrete saw are quick, they are considered slower than methods which use a water jet.

The water jet, in addition to being used to repair bomb damaged areas, is also being studied for use in civil works projects. This would include repair of damaged and deteriorated concrete in locks, dams, and other structures.

Some concrete structures have been subjected to weathering, wave action, and freezing for more than 70 years. Conventional repair methods are termed expensive and time consuming. It is believed, however, that a water jet would result in substantial savings in time, manpower, and equipment costs.

A water jet utilizes water pumped at high pressure through a constricted nozzle. This focuses the pressurized water into a "liquid knife."

The idea of using water as a cutting agent has been traced as far back as the ancient Egyptians. A crude type of water jet (Firehose and nozzle) was also used in mining operations as early as 1907. Different types of water jets are presently used to cut a wide variety of substances including fabrics, plastics, coal, etc. Water jets can also drill holes.

Although most of the development of water jets has been done in the United States, most applications of this technology have been in foreign countries.

Currently in Canada, a two-man shift is using a water jet in a coal mine to mine 3,000 tons of coal per shift. In a U.S. mine, a nine-man shift, using a continuous mining machine, can only manage 400 tons per shift.

The water jet, besides offering greater speed in most cases, causes no dust, has low noise levels, cleans the surfaces being cut, does not damage surrounding materiel, and has low vibration.

About five research labs and universities have been extensively working on the development of water jets. Some developers favor low pressure water jets (around 10,000 psi), while others use high pressure water jets (around 60,000 psi and above). Some proponents also use additives such as abrasives like sand to help the cutting action or the use of polymers to "hold" the water together. Others favor just plain water.

Personnel from the University of Missouri at Rolla and the Colorado School of Mines recently came to WES to demonstrate water jet technology and capabilities. Dr. David Summers represented Missouri while Dr. Fun-Den Wang came from Colorado. Drs. Wang and Summers both used relatively low pressure water jets. Wang also used sand and other abrasives.

The water jet demonstration took place on a 12-inch-thick airfield concrete test section. Summers used a water jet mounted on a buggy developed by Dr. Roger Raether of the North American Product Development Co. Raether's company is currently marketing this particular device commercially to remove deteriorated concrete from bridge roadways. Summer's water jet took approximately 14 minutes to cut a 6-inch-deep cut over a length of 1-1/2 feet in the concrete.

Neither group was satisfied with the results. They had had little previous experience cutting concrete. Also, they were both using water jets developed to cut other materials.

"I've had about eight to nine hours of experience cutting concrete," Summers said. He cited the development of the water jet for coal mining as an example of the progress needed for concrete water jet cutting. When water jets were first used to cut a slot in coal, they cut only a few feet an hour. Within a year they were commercially feasible after having multiplied their cutting rate many times.

Both Wang and Summers are considering several modifications that could be implemented to improve concrete cutting. These include higher water pressure (around 19,000 psi), changing the angle of the water jet nozzle to the concrete, the use of several water jets in a row at one time, and the addition of mechanical aids such as strippers.

WES Program Manager Dr. George Hammitt, of the Geotechnical Laboratory, says that WES will probably not do any in-house development on the water jet. Hammitt, who is running the military oriented airfield repair phase, said the Corps will probably have a contractor supply the water jet system built to Corps specifications if the system is eventually adopted.

The main objective for the water jet in the bomb damaged repair program is to cut 15 feet of 12-inch-thick concrete per minute. This is about a 100-fold increase in the capabilities shown at the recent demonstration. Hammitt said the key problem in cutting runway concrete is the extremely hard aggregate (the rock mixed with the cement) used which have compressive strengths of 150,000 to 200,000 psi.

The civil works phase of deteriorated concrete removal is under the supervision of Technical Coordinator Dr. Carl Pace, of the Structures Laboratory. Pace believes the potential of water jets is tremendous. He sees the lack of development in concrete cutting as the major roadblock in the program.

The Corps has asked for funding to help subsidize the research by contractors. The plan Hammitt and Pace have devised calls for the Corps to keep up with the latest developments in water jet cutting of concrete and to coordinate with the various contract researchers. This will allow the Corps to make decisions on the most cost-effective technology and the type of equipment that is best suited for the job.

Side view of cut made by water jet demonstrated by University of Missouri. Also note surface concrete (at right of photo) that was removed with only a few passes of the water jet.

Close-up of cuts made by Colorado School of Mines' water jet developed by Dr. Fun-Den Wang. The demonstration took place on 12-inch-thick airfield concrete test sections.

Carlucci Addresses National Security Industrial Association

Deputy Secretary of Defense Frank C. Carlucci was the recent guest speaker at the 38th annual dinner meeting of the National Security Industrial Association. He discussed a series of factors related to the maintenance of a strong national defense. A summary of his remarks, directed primarily at industry, follows.

The deputy secretary began his presentation by stating that a sustained defense effort is dependent upon a healthy economy. Therefore, he said, the cornerstone of the DOD program is to make the acquisition process more efficient.

Relative to the potential threat during the 1980's, he noted that it is real, large and growing, and it has a political and a military dimension. Recent events in Angola, Ethiopia, Afghanistan and Poland exemplify this threat, he added.

The ability to meet the growing menace, continued Carlucci, depends crucially on a much stronger industrial base. Said he: "We must rebuild our basic defense industries which have been too long neglected."

Carlucci stressed that reduced government participation in the contractor's internal management should significantly reduce costs. Consequently, the DOD, he noted, is going to make a genuine effort to reduce government red tape in its dealings with industry. Emphasis is also being placed on more industrial long-term investments, multi-year procurements, and shorter leadtimes.

The deputy secretary said that he recognized that the early development phases of a new weapon system must be adequately funded. However, he indicated that industry has a major responsibility to identify accurately and fully the costs of their proposals. Industry must not commit to artificially low costs during the competitive bidding process and subsequently blame DOD for inadequately funding the program.

Relative to the end-product itself, Carlucci said that the DOD wants industry to design equipment which requires the least number of operators and which is easier to support. We must avoid hardware so complex that it cannot be maintained by our military people. Whenever possible, he said, we would like to see more reliance on commercial off-the-shelf components and equipment.

Vital elements of any weapon system, stressed Carlucci, are quality and reliability of the product. He appealed to U.S. industry leadership to establish a national commitment to improve the quality and reliability of its products, along with a dedication to improve national productivity across-the-board.

Carlucci labeled the declining base as one of the most serious problems facing the U.S. However, several things have been done to deal with the problem. Tax incentives related to plant and equipment depreciation have been written into law, and contractors are being rewarded for innovative manufacturing techniques.

Other initiatives include special efforts to keep industry in the defense business and to encourage new suppliers to come in. He emphasized to the large contractors that the restoration of the industrial base cannot be accomplished without a strong subcontract structure backing up the primary contractors.

Competition, noted Carlucci, is basic to the entire acquisition program. Consequently, he has requested the Services to increase their efforts to obtain more competition by setting specific objectives. He also stressed that cooperation between the DOD and industry is essential throughout the entire acquisition process.

Deputy Secretary Carlucci concluded his remarks by stating that industry is the residual strength which represents the ultimate deterrent. He called on the industrial community to help improve military strength and the U.S. defense posture.

'Cooler' Material Eyed for Protective Clothing

What started out at the U.S. Army Chemical Systems Laboratory (CSL) as an experiment to test a new lightweight material concept for the U.S. Air Force has resulted in the development of a material that could provide the American field soldier with a lighter, more comfortable garment to wear in a chemical environment.

Tests to date have established that the new material, designated the Gore-Tex/ Charcoal Cloth CB-Laminated System, will be at least 45 percent cooler then the current standard Army-issue permeable protective clothing.

CSL engineers conceived the idea of developing Gore-Tex material for protection against chemical agents to "get rid of the heat," said Mr. Tom Mitchell, a textile engineer, who serves as the system's project officer in the CSL's Physical Protection Division.

"We laminated charcoal cloth originally developed in the United Kingdom to commercially available TEFLON film material," Mitchell explained, "and then added a tricot (knit) material for the lining. The outer layer will consist of material conforming to the needs of the individual user."

Although the current Army chemical protective garment provides full protection, the material is heavy and very hot, reducing a soldier's effectiveness during extended wear in warm conditions.

The Gore-Tex charcoal cloth offers the same positive protection and because of the make-up of the material, water vapors pass out from the wearer, providing evaporative cooling, while liquid agents are prevented from entering the garment.

Mitchell said about 100 Gore-Tex suits for wear tests have been manufactured by ILC, Dover, DE, the corporation that has extensive experience in manufacturing specialized protective clothing for the Army's Demilitarization Program and for other applications by government agencies.

Additional tests are underway to confirm the 45 percent heat stress reduction and to test the material for a protective hood.

Mitchell said that when the material development is completed it will be turned over to the Army's Natick R & D Laboratories.

Capsules . . .

OS&T Eyes R&D Areas for Funding

The Reagan administration intends to be significantly more selective in the types of research and development projects it will fund, according to *Industrial Research & Development Magazine.* In an interview with Mr. George Keyworth, director of the White House Office of Science & Technology, the publication reveals that Keyworth's office will be focusing on projects having the most likely practical payoffs, and "de-emphasizing" those R & D areas unlikely to produce results of economic significance.

Keyworth, formerly head of the Physics Division at Los Alamos National Laboratory, wants to rechannel R & D into areas meeting a standard of "pertinence or excellence." "It's not practical, nor is it desirable," Keyworth said, "for us to attempt to retain an isolationist philosophy that demands we be best in everything."

Keyworth recommended that the science community steer clear of "labor intensive industries," and instead, redirect its energies toward projects with obvious applications or with "enormous probability of breakthrough," such as high-energy physics, neurophysiology, and microbiology.

Other areas slated for generous funding, according to *Industrial Research & Development Magazine* would include material science and computer science — two areas that "clearly underlie support industries where we want to remain predominant."

In addition, military R & D is a high-priority item with Keyworth noting that since the Vietnam War, the government has been remiss in aggressively pursuing military R & D. "One of the primary responsibilities for any government," he said, "is to provide adequate national security. I think we have fallen below levels of adequate."

Battelle Developing Chemical Reconnaissance Module

Researchers at Battelle's Columbus, OH, Laboratories are developing part of a sophisticated defense ground reconnaissance system for the U.S. Army's Chemical Systems Laboratory (CSL), Aberdeen Proving Ground, MD.

According to CSL project officer Mr. Bernie Fromm, the objective is to provide the U.S. with a prototype system for use in the event of enemy attack so that appropriate defensive actions can be taken to save lives and deploy defenses. The reconnaissance vehicle is intended to detect the presence of chemical and other agents in a military zone.

The program will deal primarily with developing advanced methods and equipment to detect chemical agents and with integrating the equipment into a reconnaissance vehicle system.

Battelle will be developing a reconnaissance module that will be incorporated in a standard military vehicle the Army can use to detect and mark suspected areas. Such vehicles could be employed by military commanders to identify agents and determine hazard levels in the area, determine whether a contaminated area remains hazardous and locate suitable sites for hospitals, artillery, or other units.

As part of the 3-year project, Battelle will determine the concept feasibility for such a system, fabricate prototype system hardware for Army evaluation, and prepare a technical data package the Army can use in building the reconnaissance vehicles.

The $1.7-million project will be carried out in a number of research and engineering laboratories at Battelle as well as at selected Army installations.

New Process Improves Wastewater Treatment

Water leaving Fort Knox, KY, reportedly has less ammonia in it because of a process developed by a team at Fort Detrick, MD.

Mr. Kenneth Bartgis, an environmental engineering technician at the U.S. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, recently spent eight weeks activating the new process at Fort Knox.

Fort Knox has a relatively new water treatment plant that utilized 36 huge drums called rotating biological contactors. Wastewater from the installation passes over the drums, which contain bacteria specially selected to remove pollutants from the water.

The biological system was working well except for the amounts of ammonia remaining in the water after treatment. A decision was made to use a chemical treatment to enhance the bacteria to remove more ammonia.

The decision was based on a year-long research project at Fort Detrick that utilized soda ash to enhance bacteria for greater ammonia removal. Bartgis was responsible for transferring the process from the pilot system in the laboratory to the full-scale wastewater treatment facility at Fort Knox.

The experiment was a success. Enough ammonia was removed from the water to meet required limits.

The 8-week study at Fort Knox is one of the numerous on-site studies at Army installations worldwide conducted by the U.S. Army Environmental Hygiene Agency, located at Aberdeen Proving Ground, MD.

Contract Will Support T700 Engine Procurement

Work related to fiscal year 1981 procurement of T700-GE-700 engines for the Black Hawk helicopter, is called for under a $75,950,715 million contract announced by the U.S. Army Aviation Research and Development Command, St. Louis, MO.

Recipient of the contract, General Electric Co., Aircraft Engine Business Group, Lynn, MA, will specifically provide necessary supplies, services and materials for the manufacture, assembly and test of the T700-GE-700 engine.

The contract also stipulates that GE will renovate the recycled government furnished engine shipping containers, which includes replacement of skids, gaskets, nuts, bolts, humidity indicators, valves, dessicants and the labor cost for removing dents, repair welding and painting.

The contractor is also required to provide the sustaining tooling effort in support of the contract through December 1981, and is to provide for tool modification and improvement to sustain the maximum production rate. Production engineering support for tooling and special test equipment, and sustaining effort for those items are to be provided by the contractor along with the necessary controls to ensure that the manufacturing processes meet the prescribed standards for quality assurance.

The contract is scheduled to be in force through January 1983 and will be administered by the Naval Plant Representative Office at the General Electric plant in Lynn, MA.

T700 Engine Termed 'One of the 'Best' Ever Built

The General Electric T700 helicopter engine used in the Army's Black Hawk utility helicopter has been termed one of the best engines ever built by COL Ronald K. Andreson, Black Hawk helicopter project manager.

In ceremonies commemorating the Army's acceptance of the 500th T700 engine at General Electric's Lynn, MA plant, COL Andreson said, "the T700 is one of the most successful, if not *the*

most successful, engines developed for Army helicopter use and is a significant part of the Army Aviation Program."

The T700, in less than 100,000 hours of Black Hawk operation," Andreson explained, "established a level of maturity that traditionally has not been achieved by an engine until it reached the one million operating hour mark." He continued, "This 500th production engine, delivered ahead of schedule, continues a precedent established when the first production engine was delivered ahead of schedule in March, 1978."

The T700-powered Black Hawk demonstrated its reliability and maturity while participating in a special Rapid Deployment of Forces (RDF) exercise in Egypt this past winter. Fourteen Black Hawks accumulated nearly 80 hours of flight time in a single day in a sand-saturated environment.

The aircraft made more than 1,200 landings during the exercise, as many as 20 an hour. No engine or accessory changes were required. The RDF exercise was a demonstration of the rapid extension of airmobile forces over long distance by the Army's 101st Airborne Division.

To date, the T700 has accumulated more than 130,000 hours operating experience, including over 30,000 hours of factory operations and nearly 108,000 hours in field operations, spanning the entire range of temperature extremes and environmental exposure . . . from Alaska to Egypt.

ILS Lessons Learned Program Established

During the past few years, the Army has reportedly acquired considerable experience in the area of integrated logistic support (ILS). Unfortunately, according to Mr. Richard Stillman, an employee at the DARCOM Materiel Readiness Support Activity, this experience has generally not been shared among logistic managers and materiel developers. In order to improve this situation, the Army has initiated an ILS Lessons Learned Program to share the collective experiences of logistic planners. The program also helps enhance materiel supportability, minimize support costs, increase materiel readiness, and influence ongoing materiel systems planning.

Essentially, the program collects and documents ILS experiences. Information is received from many sources, including materiel developers, combat developers, testers, trainers, and users. Finalized lessons are then compiled into semiannual reports (RCS DRCRE-1001) and distributed to logistic planners throughout the Army.

Copies of the report or additional information about the program are available from the U.S. Army DARCOM Materiel Readiness Support Activity (MRSA). MRSA maintains the central ILS lessons learned repository and serves as the proponent for the program. Additional information is available from: Commander, U.S. Army DARCOM Materiel Readiness Support Activity, ATTN: DRXMD-EI, Lexington, KY 40511, AUTOVON 745-3393 or commercial telephone (606) 293-3393.

New Flatcars Complete Final Test Phase

The first of a new generation of heavy duty flatcars developed by the U.S. Army Mobility Equipment Research and Development Command for the Abrams tank have successfully completed tests.

Mr. Ashok S. Patil and Marcia A. Boynton of the command's Mechanical and Construction Equipment Lab supervised the evaluation of the tie-down system for the new tank in the final phase of testing at Aberdeen Proving Ground.

Both the versatile securement system and the 140-ton six-wheel flatcar were designed by MERADCOM to meet military user requirements and the standards of the American Association of Railroads.

A movable 48-chain tie-down system for vehicles permits the car to carry oversized vehicles other than its normal load of two M1 tanks. A recessed adjustable pedestal securement arrangement gives it the capability of carrying three 20-foot standard containers, or a combination of containers and vehicles. Other design features are a steel deck selected for the 140-flatcar to minimize the maintenance costs associated with wood-decked cars, and the six-wheel trucks to carry its heavy lading.

One-hundred and one heavy-duty flatcars are being built under a $12 million contract awarded to Fruit Growers Express by the Army Troop Support and Aviation Materiel Readiness Command.

The recently completed tests climax a program begun in 1978 when a Military Traffic Management Command study disclosed that the defense fleet of 80- and 100-ton flatcars was inadequate for transporting the Abrams tank and many other outsize and overweight vehicles. The present plan calls for procurement of 568 140-ton flatcars thru 1986.

Contract Calls for Near-Term Scout Helicopter

The Army awarded a $148 million contract to Bell Helicopter Textron, Fort Worth, TX, to develop the new Near Term Scout Helicopter, a modernized day/night scout helicopter capable of operating worldwide.

Development of the new helicopter is part of the Army helicopter improvement Program (AHIP) which provides for modification of existing Army observation helicopters. The contract covers full-scale engineering development and requires delivery in 1984. The Army will then conduct developmental and operational testing.

The contract also calls for incorporation of a mast-mounted sight for day and night target fighting, improved nap-of-the-earth communication and navigation capabilities, space height and power for a self defense air-to-air missile system, and a helicopter hover capability for worldwide deployment under any weather conditions.

The Near Term Scout Helicopter will provide the Army with a combat support target acquisition/designation system which will operate day and night and in periods of reduced visibility. It will be used to conduct reconnaissance, gather target information, call for and adjust indirect artillery fire and close air support, designate targets for precision guided munitions, select battle positions, assist attack helicopter movements, coordinate with ground commanders and provide local security.

Well Drilling Machines Acquired for RDF

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM) Fort Belvoir, VA, is buying two well drilling machines for the Rapid Deployment Force. The machines will be part of the RDF water supply under development by the command. Purchased at a cost of more than $1 million, the machines are being provided under an existing contract with AZCON Corp., George E. Failing Co. The original contract, awarded in 1978, included an option to purchase 12 units. So far, five have been procured for the Army and Air Force.

The drilling machine is semi-trailer mounted and is capable of drilling to 1,500 feet to complete a 6-inch diameter well. Sufficient ancillary equipment is furnished with the machine to complete and produce the well.

Conferences & Symposia . . .

DCSRDA Schedules 1982 Army Science Conference

The 1982 U.S. Army Science Conference, sponsored by the Deputy Chief of Staff for Research, Development and Acquisition, Department of the Army, will be held at the U.S. Military Academy, West Point, NY, 15-18 June 1982.

Ninety-six selected papers, judged as best among summaries submitted by Army scientists and engineers, will be featured. Authors of the most outstanding papers will be selected for special achievement certificates and honoraria. This year's special theme is the role of R & D in the Army's long-range planning process.

Attended by representatives of the U.S. Government and key scientists and engineers from allied nations, the conference is intended to provide a forum for presentation and recognition of significant accomplishments by Army scientists and engineers and to emphasize the role of R & D for the Army of the 90s.

Additional conference information may be obtained from: Dr. Frank D. Verderame, Acting Assistant Director for Research Programs, Office of the Deputy Chief of Staff for Research, Development, and Acquisition, Department of the Army, Washington, DC 20310.

30th Power Sources Symposium Slated for 1982

Technical papers describing present and future work related to batteries and other power systems will be presented during the 30th Power Sources Symposium, 7-10 June 1982, at Atlantic City, NJ.

Sponsored by the U.S. Army Electronics Technology and Devices Laboratory in conjunction with other DOD agencies, the Communications Satellite Laboratories, National Aeronautics and Space Administration, and the Department of Energy, the meeting is believed to be one of the largest of its kind in the world.

Titles and chairmen of the technical sessions programmed for the 1982 symposium are: Fuel Cell Systems, Mr. Richard N. Belt, Army Mobility Equipment R & D Command; High Temperature Systems, Dr. James E. Battles, Argonne National Laboratory; Advanced Secondary Batteries, Mr. Gerald Halpert, NASA Goddard Space Flight Center; Nickel Secondary Batteries, Mr. James Dunlop, COMSAT Laboratories; Secondary Batteries, Dr. Tien S. Lee, Argonne National Laboratory; Primary Batteries, Dr. Jeffrey Nelson, Harry Diamond Laboratories; and

Lithium/SO2 Primary Batteries, Dr. Carl E. Mueller, Naval Surface Weapons Center; Lithium/Oxychloride Primary Batteries, Dr. Sol Gilman, Army Electronics Technology and Devices Laboratory; Lithium Primary Batteries, Mr. Charles J. Scuilla, Central Intelligence Agency; Lithium Reserve Batteries, Mr. Richard Marsh, Air Force Wright Aeronautical Labs; Future Needs for Power Systems, Mr. Wayne S. Bishop; and Thermoelectric, Dr. Guido Guazzoni, Army Electronics Technology and Devices Laboratory.

Additional symposium information may be obtained from: Power Sources Division, ATTN: DELET-P, U.S. Army Electronics Technology and Devices Laboratory, Fort Monmouth, NJ, 07703 or Autovon 995-2662, commercial (201) 544-2084.

8 Americans Win First Prize in Math Olympiad

Eight young American mathematicians brought home the gold and a first place prize in the 22nd International Mathematical Olympiad (IMO), following a 3-week training session at the U.S. Military Academy. The victory was the second for the U.S. in the world's most prestigious math competition for high school students. U.S. participation in the event began in 1974 and highest honors were first achieved in 1977.

The American team was selected competitively from over 400,000 students throughout the U.S. This year's IMO was hosted by Georgetown University where 192 high school students competed in two 4-1/2 hour sessions.

Under the sponsorship of the Mathematical Association of America, the 22nd IMO was supported by the Army Research Office. They provided expert consultation and administration in developing the program. The Army has been supporting the IMO since 1976.

Four members of the American team received perfect scores, and two completed near perfect papers. The American team was comprised of Noam D. Elkies, Stuyvesant High School, New York, NY; Benjamin N. Fisher, Bronx High School of Science, Bronx,NY; Brian R. Hunt, Montgomery Blair High School, Silver Spring, MD; Greg N. Patruno, Stuyvesant High School, New York, NY; Jeremy D. Primer, Columbia High School, Maplewood, NJ; James R. Roche, Hill-Murray High School, St. Paul, MN; David S. Yuen, Lane Technical High School, Chicago, IL; and Richard A. Strong, Albermarle High School, Charlottesville, VA.

Army participation in the Math Olympiad is part of an ongoing effort to stimulate achievement and excellence in science, mathematics, and engineering. The Army Research Office is charged with administering the Army Youth Science Activities programs, which include the Junior Science and Humanities Symposium, the Army participation in the Science and Engineering Fairs, the Uninitiated Introduction to Engineering program, the Research and Engineering Apprenticeship program, and the International Mathematical Olympiad.

Personnel Actions . . .

Weckel Becomes CSL Commander-Director

COL Edward C. Weckel

COL Edward C. Weckel, chief of the U.S. Army Chemical System Laboratory's Physical Protection Division since 1979, recently succeeded BG Walter W. Kastenmayer as CSL commander-director.

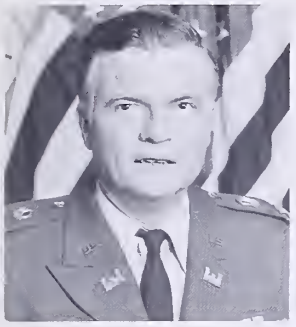
Graduated from the U.S. Military Academy in 1958, COL Weckel also holds a BS degree in physics from the U.S. Naval Post Graduate School, and a master's degree in financial management from George Washington University. He has also completed requirements of the National War College, Airborne and Ranger Schools, and the Chemical Career Course.

In 1976, COL Weckel was assigned as chief of a planning, programming and budgeting team in the Office, Deputy Chief of Staff for Operations and Plans, DA. This followed a tour as commander of Combat Equipment Battalion East, and a tour at HQ U.S. European Command, Stuttgart, Germany.

Other assignments have included executive to the Director of the Organization and Unit Training Directorate, Office of the Assistant Chief of Staff for Force Development, DA; HQ U.S. Army Combat Developments Command; chemical officer, Vietnam; and R & D coordinator, Defense Atomic Support Agency.

COL Weckel wears the Bronze Star Medal, Meritorious Service Medal with three Oak Leaf Clusters, and the Joint Service Commendation Medal.

Wintz Commands Engineer Topographic Labs



COL Edward K. Wintz

COL Edward K. Wintz is the new commander and director of the U.S. Army Engineer Topographic Laboratories at Fort Belvoir, VA. During the past two years he served as district engineer, U.S. Army Engineer District, Riyadh, Saudi Arabia. From 1975 to 1979, he was director of the Defense Mapping School at Fort Belvoir.

His previous tours include the Army Map Service's Project Betty in the Philippines, Midway and Hawaii (1959-1962) teaching astronomy and physical geography at West Point, and an assignment as mapping officer and commander, 227th Engineer Detachment, in Vietnam. He was also director, Advanced Systems, and commander, Troop Command, U.S. Army Topographic Command. He commanded the 30th Engineer Battalion (Base Topographic) from 1971 until 1973.

COL Wintz graduated from the University of California (Berkeley) in 1955 with a bachelor's degree in civil engineering and an ROTC commission in the U.S. Army Corps of Engineers. He received his master's degree in geodetic science from Ohio State University (OSU) in 1961, and a doctorate in the same subject was awarded to him by OSU in 1965. He completed the Command and General Staff College in 1970 and the Army War College in 1975.

He has been awarded the Bronze Star, Defense Superior Service Medal, Meritorious Service Medal (Oak Leaf Cluster), and the Army Commendation Medal.

Evans Chosen as WES Deputy Commander

LTC John O. Evans III

LTC John O. Evans III has been named deputy commander and director of the U.S. Army Engineer Waterway's Experiment Station (WES) in Vicksburg, MS. He has served since November 1980 as facilities engineer in support of the 2d Infantry Division in Korea.

LTC Evans earned a bachelor's degree in architecture from Texas Tech University and a master's in urban studies from Trinity University. Active in the ROTC program while at Texas Tech, he was commissioned in the Corps of Engineers upon graduation in 1963.

His military education includes the Engineer Officers Basic and Advanced Courses, the Command and General Staff College, and the Defense Language School.

During his 17 years of military service, LTC Evans served six tours overseas, two of those in Vietnam. He served as an advisor to the Liberian Engineer Battalion in West Africa; as a resident engineer for the Saudi Arabia District of the U.S. Army Corps of Engineers; and as an engineer advisor in Bolivia where he also taught at the Bolivian Military Academy.

Stateside assignments have included the 588th Engineer Battalion at Fort Lee, VA; recorder for the Faculty Board of the Officer Candidate Regiment at Fort Belvoir, VA; assistant resident engineer with the San Antonio Resident Office of the Corps of Engineers, Fort Worth District; the Little Rock District of the Corps where he worked on an urban study; and as facility engineer, Defense Construction Supply Center (Defense Logistics Agency), Columbus, OH.

Military decorations and awards include the Meritorious Service Medal, the Bronze Star, the Joint Service Commendation Medal, and the Army Commendation Medal.

Evans is a professional registered architect in Texas and is certified by the National Council of Architecture Registration Boards. He is also a member of the Society of American Military Engineers.

Career Programs . . .

Saibel Heads Engineering Science Society

Dr. Edward A. Saibel

Dr. Edward A. Saibel of the Engineering Sciences Division, U.S. Army Research Office, Research Triangle Park, NC, has been elected to a 1-year term as president of the Society of Engineering Science. He served previously as the Society's vice president and on its board of directors.

Responsible for management of major elements of ARO's solid mechanics program, Dr. Saibel joined ARO in 1972. He has served on the faculties of the University of Minnesota, Carnegie Institute of Technology, and Rensselaer Polytechnic Institute.

Dr. Saibel has authored or coauthored more than a 100 scientific papers in various journals and he has lectured extensively in the U.S. and abroad. Additionally, he has been credited with outstanding contributions to hydrodynamic lubrication, friction, and tire wear technology.

Decareau Named Microwave Institute President

Dr. Robert V. Decareau, food technologist at the U.S. Army Natick R & D Laboratories, Natick, MA, has been elected president of the International Microwave Power Institute. He has also received recognition from the Institute of Food Technologists through their Scientific Lectureship Program.

Decareau earned a BS degree, a master's degree, and his PhD, all from the University of Massachusetts. He served two years in the U.S. Navy and two years in the U.S. Army.

Dr. Decareau joined the Natick research installation in 1968. Since that time, he has been recognized by NLABS on numerous occasions for excellence within his field. In 1980, Decareau was one in a group of scientists awarded the Technical Director's Silver Pin for Engineering for his role in a new combat food service system which enabled frequent delivery of high quality hot meals to highly mobile and dispersed combat forces.

In addition to his professional membership in the International

Microwave Power Institute and the Institute of Food Technologists, Decareau is also a founding member of Phi Tau Sigma Honorary Society.

Brown Begins CSL Technical-Executive Training

H. Arthur Brown, a research chemist at the U.S. Army Armament R & D Command's Chemical Systems Laboratory, has begun technical executive training at the CSL, Aberdeen Proving Ground, MD.

Prior to his selection as the 41st civilian employee to participate in the 6-month training program, Brown was assigned to the Chemical Branch in CSL's Research Division.

He was appointed to Federal service in 1958 after serving three years in the S & E program and enters the training program with experience in chemical research and chemical munitions development.

He was awarded a bachelor of science degree in chemistry by the Lebanon Valley College in 1953 and a master's degree in physical chemistry by the University of Delaware.

The CSL exec training program includes a 3-month work experience in the office of the CSL commander-director and a similar period of training at the headquarters of the Army Materiel Development and Readiness Command (DARCOM) in Alexandria, VA.

Awards...

Gillich Receives BRL's 1981 Kent Award

Dr. William J. Gillich

Dr. William J. Gillich, a research physicist who is chief of the Penetration Mechanics Branch in the Ballistic Research Laboratory (BRL) Terminal Ballistic Division, has been awarded the 1981 R. H. Kent Award.

Established in 1956, the award honor's BRL's prominent scientific leader, Dr. Robert H. Kent. It is the highest commendation made annually by BRL to recognize achievements in scientific and engineering research.

Dr. Gillich is recognized as an authority on kinetic energy penetrators as well as armor and anti-armor threat prognostication. He was commended for his role as leader of a group of BRL scientists and engineers working in the forefront of anti-armor and armor technologies that evolved from basic research into army weapons systems such as the M1 Abrams Tank, and the XM829 and the XM833 kinetic energy projectiles.

Dr. R. J. Eichelberger, BRL's director, presented the award at a dinner ceremony attended by Gillich's family, friends, associates and former Kent Award winners.

Dr. Gillich was appointed to Federal service in 1963 at BRL after serving a tour of duty as a military officer in the Ordnance Corps. Today, he directs the activities of more than 35 scientists, engineers and administrative personnel in the science and technology of anti-armor and ammunition research programs.

He was awarded a bachelor of science degree as well as a master degree in mechanical engineering by Johns Hopkins University where he also received a doctorate in the Department of Mechanics in 1964.

8 MERADCOM Employees Get CO's Awards

Eight employees of the U.S. Army Mobility Equipment Research and Development Command were honored recently during MERADCOM's 24th Annual Commander's Awards ceremony at Fort Belvoir, VA.

MERADCOM Commander's Awards recognize achievements in science, technology, leadership, and technical and administrative support (Gelini Medal). An award is also presented to the outstanding MERADCOM laboratory.

This year's scientific achievement award went to the team of Mr. Allan T. Sylvester, Mr. Stanley F. Koutek, Mr. Fred L. Lafferman, and Ms. V. Susan Estes for their formulation of a new chemical coating for Army tactical materiel.

Mr. Peter M. Pecori received the Commander's Award for Technological Achievement for implementing technology leading to an enhanced mine detection device capable of operating in desert environments. The leadership award went to Mr. Nicholas A. Caspero for directing a greatly expanded program and for successful procurement of the 600 GPH Reverse Osmosis Water Purification System.

The Gelini Medal, named in honor of COL Walter C. Gelini, a former MERADCOM commander, was presented to Mr. Robert G. Jamison. He was cited for his technical support in advancing the state-of-the-art of new analytical instrumental technologies in MERADCOM's fuels and lubricants program.

The Outstanding Laboratory Award for 1981 went to the Energy and Water Resources Laboratory. It was accepted by acting lab chief Mr. Kenneth E. Hasle. Also featured at the award's ceremony was a keynote address by DARCOM Assistant Deputy for Science and Technology, Dr. Richard L. Haley.

'VuPoints'...

Dear Editor:

I'm harkening to your request for reader comments in the July-August 81 issue regarding improved use of resources.

Having been commissioned 25 years and working in R & D off and on, and observing developments as a user of the results of R & D I submit:

a. We are defeating the system the military is to defend - free enterprise. There is no rationale to duplicating efforts already existent in industry. Army labs should pursue only Army peculiar endeavors not possible in the civilian sector.

b. Army R & D must take advantage of solutions offered by industry and not succumb to the "NIH" syndrome often seen as the reason for turning down proposals.

c. Priorities must be placed to address the most critical items first.

As example, it doesn't make sense to seek marginal *improvements in capability to anchor fuel tankers off-shore if there is* no *capability to handle the delivery rate from the on-board pumps.*

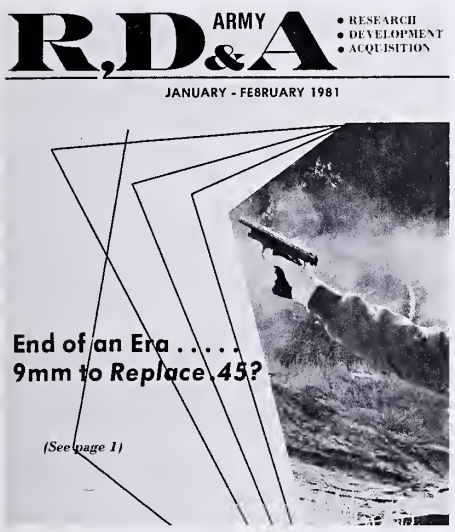
Sincerely,

PHILLIP D. WEINERT
Colonel, CE
U.S. Army

1981 Index of Army RDA Magazine Articles

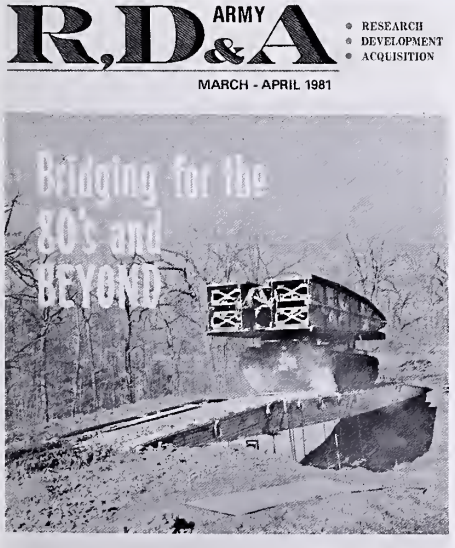
The following is a headline list of feature articles published in the Army RDA Magazine *during calendar year 1981.*

JANUARY — FEBRUARY



- Toward A New Hand Gun.
- Microelectronics Availability For the U.S. Army's Missiles.
- The Communications Systems Engineering Program.
- DATAMAP: A Versatile Data Management And Analysis System.
- The Problems Of Abbreviations And Battlefield Automated Systems.
- XM 249 Machinegun Selected As Candidate For SAW.
- Nuclear Munitions Acquisition.
- Improving Productivity Through Manufacturing Technology.
- GEN Guthrie Reviews 1980 Productivity Growth.
- ADPA Conferees Examine DOD Energy Requirements.
- Battelle Forecasts $68.6 Billion For 1981 R & D.

MARCH — APRIL



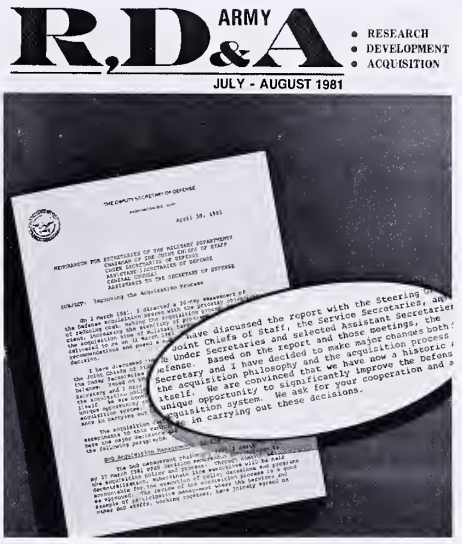
- A New Generation Of Mobile Bridges.
- Status Of Gasohol Evaluation And Its Procurement Within DOD.
- Multiple Launch Rocket System — The Future Is Now.
- Stinger: Designed To Meet The Threat.
- Joint Interoperability Of Tactical Command And Control Systems.
- Viper Nears Completion Of Engineering Development Phase.
- Army Solves Desert Mine Detector Problem.
- Weinberger Announces FY 81/82 Defense Budget Revisions.

MAY — JUNE

- Fighting Vehicles: The Next Generation.
- Corrosion And Corrosion Control.
- Interview With WRAIR Director/Commandant COL Philip K. Russell.
- Digital Mapping On Display.
- Side-Looking Laser Altimeter May Improve NOE Simulations.
- Development Of A Long-Life Coolant System For Military Vehicles.
- Powder-Filled Structural Panels For Helicopter Fuel Fire Protection.
- Aviator Night Vision Goggles With Sub-Miniature Instrument Display.
- ARRADCOM Establishing Electro-Magnetic Propulsion Laboratory.

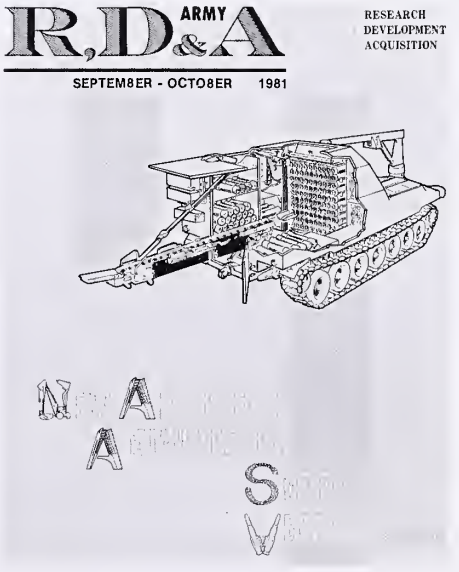
JULY — AUGUST

- Decisions Made On 31 Recommendations To Reduce Costs And Improve Management Principles And The Acquisition Process.
- Atlanta VII: The Opportunity And The Problem.
- HQ DARCOM To Be Realigned.
- Army Aircraft Occupant Crash-Impact Protection.
- A Rebirth Of Chemical Research And Development.
- End Of An Era: Army Truck Fleet Takes On Modern Look.
- Force Modernization And Materiel Acquisition.
- Engineering For Producibility.
- Evaluation Of Engine Designs.
- Joint Army/Marine Project Manager Office Established For Light Armored Vehicle.



SEPTEMBER — OCTOBER

- New Field Artillery Ammunition Support Vehicle.
- Interview With Human Engineering Laboratory Director Dr. John D. Weisz.
- Army R & D Achievement Awards Presented To 49 In-House Army Scientists, Engineers.
- Toward A New Vehicle Armament.
- Resources Optimization Via Training Devices.
- New Ammunition Devices May Ease Huge Training Costs.
- Annual Listing Of DARCOM Program/Project Managers.
- Vision Blocks: A Greenhouse Of Armor.
- New Blackout Security Lights.
- Ammunition Interoperability.
- Applied Technology Laboratory Provides Support to National Aeronautics and Space Administration.
- Army Converts To Silicone Brake Fluid.
- Waterways Experiment Station Developing Tactical Bridge Access/Egress System.



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